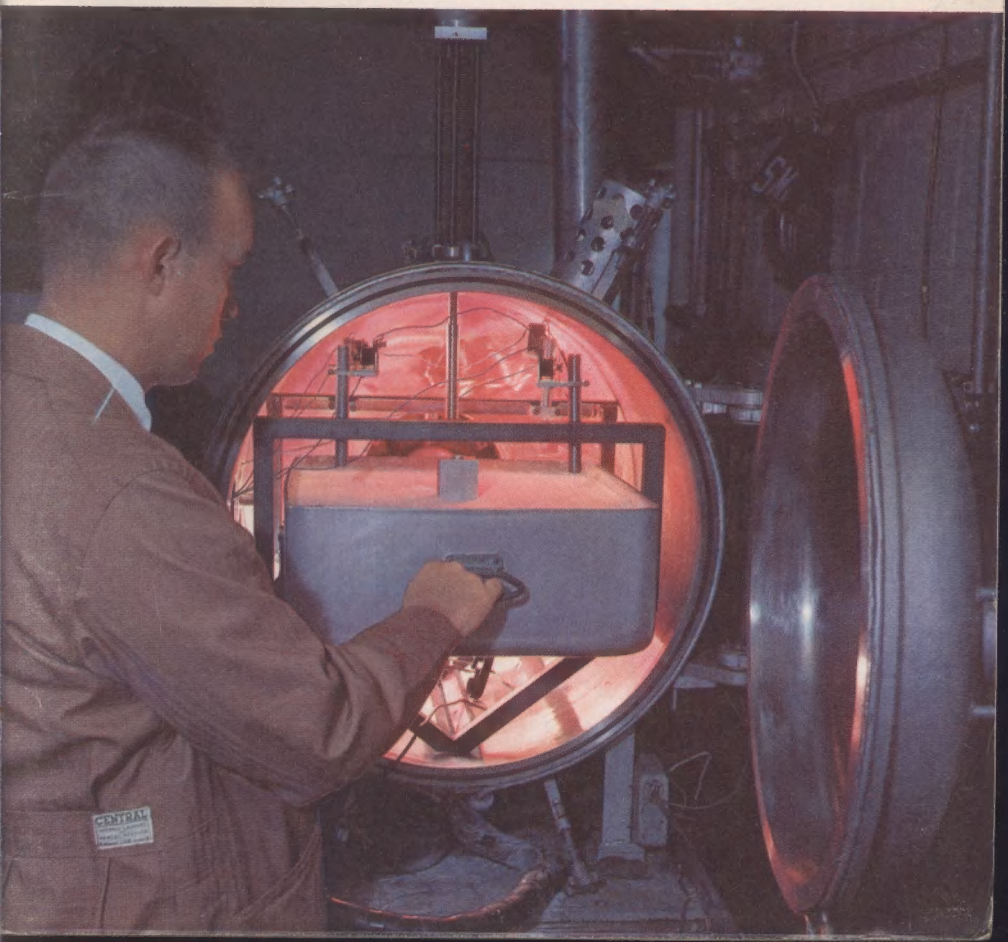
MARCH 1963 35 CENTS ICD

SCIENCE DIGEST

SECRET U.S.-SOVIET SATELLITE WAR IS POSSIBLE

NEW MOON LANDING RESEARCH – the moon dust hazard

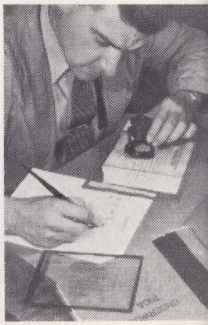


In this issue . . .

What mysterious purpose lay behind the construction of the gigantic temple at Abu Simbel: Sunlight creates an Egyptian god.

Heinrich Schliemann thought this was the face of Agamemnon.: A Science Milestone.

Moon craters are being made in the laboratory to help plan for flights to the moon and other planets: Landing men in moon dust.



A letter can tell more than the writer wants it to: Solving crimes on paper.

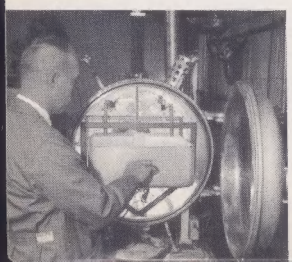
Because of modern engineering it will take less time to drive between New York City and Florida: Driving across Chesapeake Bay.

This missile may be able to knock down another missile, some day it may also be able to knock down a satellite: Destroying enemy satellites.

How did this visitor from Europe get here? Who brought the stork?

Therapy techniques for arthritis victims: The Progress of Medicine.

The griffin never existed but: Crossing species produce strange life forms.



The Cover This Month—

A container of simulated moon dust is placed in a vacuum chamber, in an attempt to learn more about what will happen to the surface of the moon when men land there—Photo Armour Research Institute, IIT.

SCIENCE DIGEST

Twenty-seventh year of publication

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ELLIS MOTT, *Editor*

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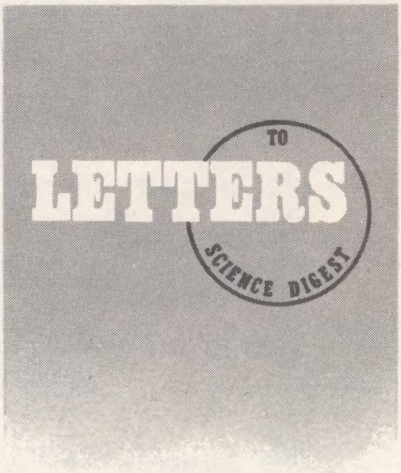

Hypnosis and Brain Surgery

In "What's On Your Mind" (Dec. '62), you mention a case which you say was the first time hypnosis was used for brain surgery. First you do not state when this operation took place. Secondly, I know of a case when hypnosis was used for brain surgery that took place back in 1958. I quote from an article that appeared on the front page of the *Dallas Morning News*, June 19, 1958.

"Brain surgery was done on Fred Heywang (50) of Dallas in Parkland Hospital while he was under hypnosis. Reason for brain surgery was palsied tremors which Fred had had since 1938.

"The operation was performed under close cooperation of the neurosurgery, psychiatry, anesthesiology, and pathology departments of the University of Texas-Southwestern Medical School, in Dallas.

"A psychologist from Southwestern Medical School was the administrator of the hypnotic trance."

Undoubtedly, you were not aware

of this operation before making such a bold statement. Otherwise I find *Science Digest* quite interesting and informative. I especially enjoy the articles pertaining to psychology and its various applications.

James M. Dickson
North Texas State University

No 'Not'

In the article "Talking to Life on Other Worlds," (Jan. '63) by Melvin Calvin, you stated that Venus does not have an atmosphere. Like earth, Venus does have an atmosphere. This is shown by the fact that near inferior conjunction with the earth the extremely thin crescent of the visible portion of the illuminated hemisphere has been observed to exceed 180°, while at the time of actual entry on the sun's disk during the transit of 1882, as soon as about three-quarters of the planet's body was in front of the sun, the remaining portion was completely outlined by a narrow border of light.

Edgar Torbert, III
Greensboro, Ala.

The "not" is, of course, an error. Dr. Calvin's original statement was "Venus does have an atmosphere." In the same paragraph he goes on to say, "Its atmosphere seems to be occupied, at least at its higher level, by a cloud impenetrable to visible light." Another article in the same issue, "Venus: Jungle or Desert?" discusses the atmosphere of Venus, and on the inside back cover of the January issue is a photograph of the last transit of Venus. In the caption we state "A transit of Venus offers observers a good opportunity to study the atmosphere of Venus."—Editor

Life As We Don't Know It

In "Venus: Jungle or Desert?" (Jan. '63), it is mentioned that the temperature of Venus may be 600° F, and that life could not exist. Life as we know it, but what about people (?) who have their bodies adjusted to such conditions. If this is true for Venus, the other seven planets (and possibly their moons!) may have life adjusted to their conditions.

Just to offer an example of adjustment: fish that live miles under the ocean have their bodies adjusted to the tremendous pressures there. But if a diver went down unprotected he would be instantly crushed. If an astronaut went on a planet with an average temperature of 600° F, his blood would boil instantly, but what about the planet's inhabitants?

Neal D. Hulkower
Pennsauken, N. J.

At the recent meeting of the American Association for the Advancement of Science, the data from the Venus probe Mariner II was analyzed, and it was decided that temperatures on the hot side of the planet (Venus seems to be turning very slowly on its axis and one side is very hot, the other very cold) do reach 600° F. Also the planet has no measurable magnetic field, and the surface must constantly be bombarded with cosmic radiation from space. Scientists concluded that there was virtually no chance of life on Venus.—Editor

Wonderful As Usual

Your December issue was wonderful as usual.

Carl R. Berg
Bainbridge Island, Wash.

Landing men on moon dust

by Nicholas A. Weil
Condensed from *Frontier*

TRAVELERS from earth will soon be landing on the moon. Once that satellite has been conquered, their ambitions will turn toward Mars, Venus, Mercury, and then the stars. These feats are now calmly accepted by the world's populace since the United States and Russia have committed themselves to space exploration.

Landings on the moon will consist of both stationary instrument packages and land-roving instrumented vehicles. Both types will be partially controlled by remote command and will telemeter information back to earth. These unmanned instrument packages are expected to provide sufficient information regarding the lunar surface to allow safe human landings on the moon. Eventually the same sequence will be followed regarding Mars and Venus.

In the face of these plans, it is amazing how little is known about the surface of the planets—or even of the moon, our closest neighbor. Yet an accurate knowledge of their surface is imperative for the design of spacecraft and for successful lunar and planetary exploration.

Fragmentary information about the moon's surface has given rise to many different theories, which in some cases contradict each other. Information on the surfaces of the planets is so scarce that there are no coherent theories about conditions that might be encountered.

In predicting lunar and planetary surface conditions, it should be understood that all one can do is to summarize man's knowledge to date and then set up hypotheses on the most probable conditions likely to exist. The following hypotheses represent the author's views, which have taken into account existing information and presently accepted theories.

Available evidence strongly suggests that there is a layer of dust on the open surfaces of the moon, such as the maria, although its depth cannot be more than a few centimeters. In the craters and ring-walled plains, comparatively deep dust beds could have been formed, for here the slopes, exceeding the natural angle of repose for fine particles under lunar environmental conditions, would have been

Frontier ©1961, by Armour Research Foundation of Illinois Institute of Technology.

re-exposed to thermal decomposition by repeated dust slides.

Only the lunar highlands and the rims of craters appear to be free of dust, and in these regions bare rock is likely to be encountered. This rock is very slowly being decomposed into dust due to the alternation of lunar day and night, light erosion, and the impact of meteorites on its hard surfaces.

Dust on the slopes of the lunar craters may increase in thickness to several hundred feet as one descends to lower elevations. This dust is relatively loose, because of the lessened gravitational field of the moon and because of the repulsive force of electro-static charges.

It is conceivable that some cementation of the top surface may have taken place. The surface of the dust layer lies at an angle seldom exceeding six degrees, equaling the angle of repose of this material under its environmental conditions. This dust moves downhill, because of reflected sunlight, solar proton bombardment, and lunar gravitation.

It may also be assumed that the dust covering lunar slopes is in a state of precarious equilibrium. Any substantial disturbance, such as lunar seismic activity, the impact of large meteors, and the landing of

Mt. Wilson and Palomar

The moon in the region of Copernicus as seen through the 200 inch telescope at Mount Palomar Observatory. The diameter of the large crater exceeds 50 miles, its depth is approximately 12,000 feet.

instrument packages, might set off a lunar "dust avalanche."

The bottoms of lunar craters are probably filled with dust layers that may range up to several kilometers thick. Under the weight of the overburden, the dust must be more compacted in lower stratifications. The electrostatic charging that the lowermost layers may once have acquired has long since leaked away. The deep layers of lunar dust possibly contain some moisture, originating mostly from impacted meteors, and may be cemented by moisture frozen into ice at the low temperatures prevailing there. Their apparent cohesion must be very high, since friction between the grains is likely to be substantial from the absence of gaseous or liquid lubrication. Hence the bottom layers, cemented or not, are likely to be quite hard.

The density and apparent cohesion drop as one proceeds up through the crater dust beds to the surface, where the same fluffy conditions are expected to hold in the layers constituting the upper few feet as those already described for lunar slopes.

The dust cover of the maria is far thinner. In convex maria, it is probably only centimeters thick. Flat or concave maria are overlaid by dust up to several centimeters thick. Beneath this thin mantle of dust lies rock.

Particles From Space

The particle spectrum distribution of the lunar dust is likely to vary over a broad range, from one micron to ten centimeters, with a distribution weighted toward the finer particles. The finer constituents originate from the galactic dust shower and the condensation of meteoric material vaporized upon impact. The medium-sized particles are the result of the thermal decomposition of the rocks, while the largest particles are made up of various typical galactic particles which remained intact upon impacting into the loose dust.

Excepting for the very bottom layers formed during the first few eons of the moon's existence, when crater shaping activity was high, the remainder of the dust—its source being mostly lunar rock and captured galactic dust—is likely to be very close in composition to the chemical constituents forming the moon.

In light of these hypotheses, the possible choices for a lunar landing would be the barren rock of lunar crater rims, the shallow dust layers of the maria, or the deep dust beds of the lunar lowlands. Landings on the lunar slopes may start disastrous dust avalanches, burying the equipment. Landing on the exposed

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Dr. Nicholas A. Weil is director of mechanics research at the Armour Research Foundation. He has authored numerous technical papers in the fields of stress analysis, material properties, metal forming techniques, dust entrainment conditions, lunar and planetary studies, and pressure distribution in soils.

lunar rock entails few unknown conditions. Since these areas constitute an extremely small part of the lunar surface, the guidance problems that would have to be solved for a successful landing appear to rule out this possibility.

Logically the landing target should be one of the lunar maria. These areas are reasonably smooth and wide open and therefore most easily impacted. Landings in the maria, if their surface is as envisioned here, would be somewhat softened by dissipating some of the landing energy to permit the vehicle to scatter and partially settle into the thin dust layer covering the maria. Exploration of the craters and high topographic features would then be conducted from base camps established in the maria.

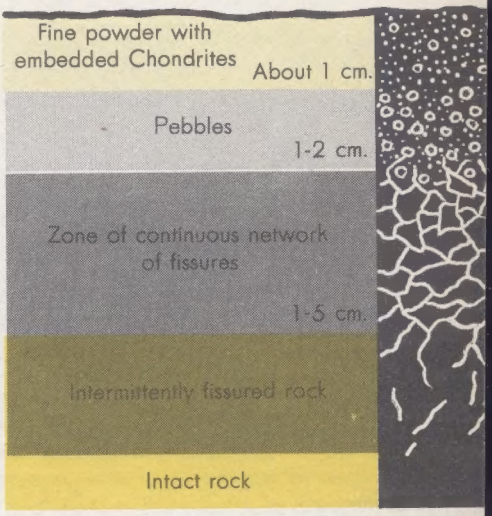
Swallowed Up in Dust

The floors of craters or mountain-ringed plains appear to offer poor landing targets. The landing vehicle might settle into a thick layer of loose dust until it is completely swallowed up.

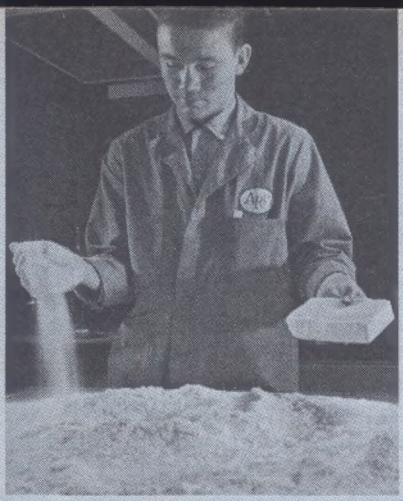
Even for landings in the maria, one will have to learn what conditions of impact, deceleration, stability, resistance, consolidation, settlement, and locomotion are likely to exist in dust layers in the centimeter-meter thickness range exposed to lunar environments.

Once the moon has been conquered, man's interest will naturally turn outward into farther space. Three planets, Mercury, Venus, and Mars—called terrestrial planets because their density, composition, and probable interior structure are reasonably similar to those of earth—will be of first interest. Facts regarding the surface conditions on these bodies are extremely meager.

Mercury appears to be comparable to our moon in most of its as-



Theoretical cross section of an undisturbed section of the maria of the moon. Chondrites are meteoric stones containing chrondules, rounded particles that are believed to originate in space. Masses of chrondules can usually be found in meteoric stones. Chrondules usually consist of enstatite and chrysolite. Enstatite is an orthorhombic mineral of the pyroxene group. It varies in color from grayish-white to olive and brown. Chrysolite is a magnesium iron silicate usually green in color. It occurs in crystals, masses and grains.



A handful of dust—moon dust made here on earth—cascades from the hand of Robert D. Rowe, research technician of the Armour Research Foundation of the Illinois Institute of Technology. At the Foundation, experiments simulating the lunar environment are carried on to gain information necessary to the success of forthcoming landings on the moon.

One of the most successful experiments has been the creating of lunar soil—or moon dust. Telescopic observations of the moon, using the visible, infrared, and radio wavelengths of the spectrum suggested to soil mechanics expert Ernest T. Selig that the nearest thing on earth to actual moon dust was sand containing more than 99 percent silicon dioxide washed and ground into an extremely fine white flour. Yet, this almost intangible dust compresses into solid chunks under varying levels of pressure. Both forms of the material are shown in the pictures at the top of the page.

In vacuum chamber experiments, rods and cubes of different materials are either dropped or laid on the dust in order to observe their penetration. How deeply they sink and what they do while sinking may help give the researchers some idea of what instruments—and astronauts themselves—can expect on lunar visits.

In the experiment pictured above a tray of dust was placed in a vacuum. Two rods were put into the dust. The two rimless holes in the center were the result. When air was let into the vacuum, the two craterlike holes on either side were created by the penetrating rods. The presence of air causes this reaction in the moon dust.

pects. Observations indicate that Mercury has virtually no atmosphere. Best current estimates indicate the existence of a thin atmosphere, having a pressure of about .0003 that of our own and of unknown composition. The surface temperature on the side permanently facing the sun averages 370° C.; on the unlighted side it is near absolute zero. For lack of a significant atmosphere, there is little convective heat transfer from one side to the other.

The disintegration of surface rocks due to changes in temperature is unlikely to occur, since surface temperatures on the planet are steady. One may assume the presence of igneous basalt and dark lava, forming an irregular, rough surface. Owing to the surface temperatures on the lighted side, there are likely to be molten pools of zinc and tin, if these elements happen to exist on the planet.

Because of its location near the sun, the density of the cosmic shower of particles descending upon Mercury is likely to be much greater than it would be for a body located near the orbit of the earth. Therefore, the planet's surface is probably covered with a layer of dust several times as deep as the estimated minimum of two to three centimeters on the moon. Mercury's surface, like the moon's, will also be found to show extensive crater formations caused by meteoric impact.

Neither violent storms nor any erosive forces act on its surface. Mercury is "dead," much like our moon, and the problems of landing on Mercury appear to be similar, except that they are complicated by a higher temperature. More moderate temperatures may possibly exist in the twilight zone between the light and dark sides of Mercury in which landings could be successfully accomplished.

Venus has physical characteristics most closely approaching those of earth. However, we know virtually nothing about its surface since all we see is its atmosphere.

Volcanoes on Venus

Because of their similarity, we can assume that volcanic activity on Venus was comparable to that of earth and may still be in progress.

The inferred surface temperatures make it improbable that there is any liquid material on the surface of Venus. Because of shifting streaks, nebulous bands, and changeable bright areas observable in the atmosphere, it is generally assumed that the atmosphere is in a state of violent motion, swirling great clouds of dust to large heights. The accompanying erosive action has probably covered the surface with a deep layer of finely eroded sand.

Venus' surface, then, is in a murky twilight, hot and dry, overlaid by an atmosphere that is rent by violent storms, generating huge dust clouds, and exerting an enormous erosive action. Because of this, there are likely to be extensive and deep dust beds on Venus but

few surface features breaking the monotony of the terrain. The dust is ground to a particle size on the order of two microns or finer. The violence in the atmosphere—as well as the dust and a terrain that may be shifting constantly, as the sands of a desert during high winds—will be a serious hazard in any landings attempted on Venus.

Photographs of Mars

Mars is the only celestial body, except the moon, whose surface features can be photographed and measured under telescopic observation. Information accumulated to date shows the existence of white polar caps—large areas whose color changes from gray to dark green with seasonal variations; vast permanent orange expanses; and a network of thin lines sometimes identified as "canals."

Mars has pronounced seasonal variations, with the seasons about twice as long as those on earth, during which the surface temperature ranges from $-120°$ to $+30°$ C. When the northern hemisphere is in the "winter" season the dark green areas change to brownish gray. Based on this, we speculate that some simple form of life—lichens and mosses—is likely to exist on Mars. The reddish-orange areas show little color change with the seasons.

The retreat of the polar caps during summer is not uniform. There are always small patches in the same location that hold out for weeks after the whiteness disappears from the surrounding area. This suggests substantial differences in elevations on the Martian surface, in the form of plateaus having mild slopes and heights not exceeding 10,000 feet. High mountains, however, are not expected on Mars, since no irregularities have been noted.

The polar caps are almost certainly formed of water in view of the prevailing Martian temperatures (too high for dry ice to form), the reflectivity of the caps (far lower than that corresponding to CO_2), and recent polarimetric measurements.

The true color of Martian soil is moderately reddish. These areas cover 75 percent of the Martian surface and are assumed to be barren deserts consisting of a granular or powdery form of iron oxide.

'Blue Haze' is Red

Mars is surrounded by a "blue haze" whose color is actually red by all standards, and therefore definitely has an atmosphere. This atmosphere is known to be some 40 kilometers high. Spectroscopic evidence shows only the presence of CO_2 in the Martian atmosphere, with no indications of water vapor, oxygen, methane, nitrogen, and noble gases.

Erosive action has been forceful on the surface of Mars, but the planet has retained some differences in elevation, as evidenced by plateaus and relatively narrow and shallow depressions—the canals.

Most of the surface is desert consisting of granulated or powdered iron oxide. A thin layer of vegetation covers about one-quarter of the surface, and a thin ice cap forms at the poles, the sizes of both of these regions changing with the seasons. The atmosphere is thin—only one-tenth that of earth—and is in violent motion, generating great dust storms. Because of the filtering action of the atmosphere, objects on the surface would acquire a deep reddish tint.

Of the three terrestrial planets, Mars appears to offer the fewest complications for a landing, particularly since such a landing can be planned to take advantage of the decelerating action of the Martian atmosphere, the rather temperate climatic conditions, and the fact that the surface is expected to contain no gross irregularities.

More Than Columbus

The information we have been able to gather about the surface conditions of the moon and terrestrial planets is sketchy. Yet, in contrast, Columbus knew far less about his destination than today's astronauts know about theirs. Precise observation of the moon, Mars, Venus, and Mercury have at least given us a basis in fact upon which reasonable hypotheses can be built.

'INERT' GAS PRODUCES NEW COMPOUND

XENON, SUPPOSEDLY an inert gas, has been made to react with fluorine. The new chemical compound, called xenon tetrafluoride, establishes the first combination of xenon with another single element.

The new compound was made by three Argonne National Laboratory scientists, John G. Malm, Henry H. Selig, and Howard H. Claassen, who placed one part xenon and five parts of fluorine—both gases at room temperature—into a sealed container which was heated for one hour at 400 degrees Centigrade. After the container was rapidly cooled in water, colorless crystals of the new compound were found inside. A reaction between the crystals and hydrogen later created hydrogen fluoride and free xenon.

According to the scientists, the two elements combined in the following way: Chemical recombination of elements is determined by the arrangement of the electrons that orbit around the nucleus of each atom. These outer shells of the atoms can contain no more than a known number of electrons. Elements that react easily contain an unstable number of electrons in their outer shell. In seeking a stable outer shell they must either acquire or lose a few electrons. Their search for stability encourages them to combine with another element and share some of its electrons.

Because of their assumed complete shells of planetary electrons, xenon and other inert gases were previously believed uncombinable with elements that share electrons.

Solving crimes on paper

Not all crimes are committed with a gun, knife or lead pipe. Some of the most ingenious criminals have used nothing more lethal than a pen.

by Nigel Morland

Condensed from a chapter of the book, *Science in Crime Detection.*

A particularly elaborate forgery was executed by a man who cut up several letters written by the person whose handwriting he wanted to imitate. Separate words from the various letters were pasted on to a sheet until a complete document was assembled.

The result was photographed and enlarged to size. A tracing was made by laying a sheet of paper over the photograph, and a technically expert duplicate of a false document was produced.

Forgery was not suspected, but the document was shown to a police expert as a matter of routine. By magnification the line quality of

1. In the document section of the FBI laboratory in Washington, technicians prepare a giant enlargement of an extortion note for a demonstration in court.

2. An example of secret writing is revealed by use of ultraviolet light. Secret writing, however, is not as common in real crime as it is in detective fiction.

3. In order to determine the source of an extortion note a technician in the FBI laboratory matches the torn edges of the note against the torn edges of a page of a notebook.

4. The contents of a partially obliterated suicide note are revealed by an infrared photograph (left).

5. An FBI technician develops obliterated writing on a check through use of iodine fumes.

6. An FBI technician uses a hand lens to examine a sample of typewriting. Typewriters have individual characteristics which an expert can easily pick out. The FBI keeps a file of common faces from different makes of typewriters.

Science In Crime Detection, by Nigel Morland, ©Nigel Morland 1958; Reprinted by permission of the publishers, Emerson Books, Inc.

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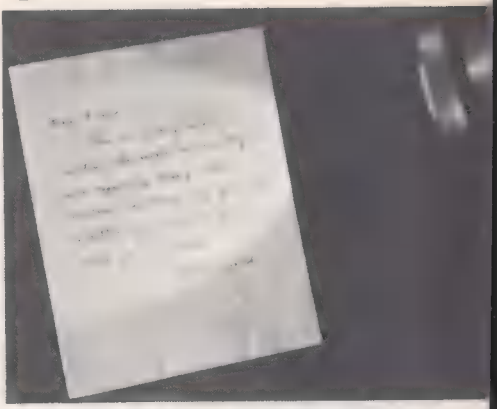

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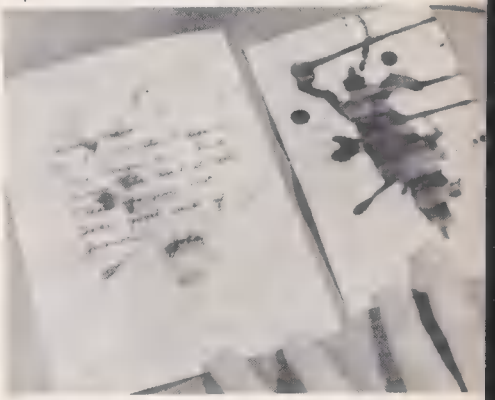

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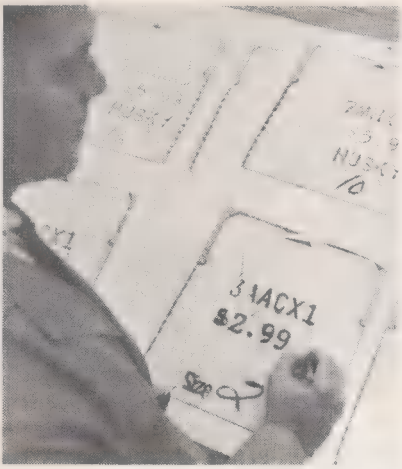


Photographic enlargements of documents may show investigators something they missed in the smaller original. Such enlargements are also useful as evidence in court. Here a technician marks enlargements for court.

the writing was seen to be inconsistent. An added irregularity was an absolute regularity of spacing between words, a characteristic never exhibited by the original writer. There was also a tendency in the letters used as models to decrease in size at the end of each sentence, an idiosyncrasy the forger had overlooked.

CRIMINAL investigation is often concerned with documents.

The document expert, when called upon for his opinion, has available a number of techniques. Some of his techniques will, of course, include the investigation of paper. In its modern sense, paper is an aqueous deposit of any vegetable fiber in sheet form. The name is derived from the Latin, papyrus, which in fact preceded paper and was used by the Egyptians. It consisted of pith from a plant, sliced in layers, then beaten and pressed into sheets.

The next materials of historical importance were parchments, produced from the skins of sheep and goats, and vellums, from the skins of calves and kids. But at an unknown date the Chinese were using silk, thin fibers of wood, and grass, as writing materials.

Indeed, nearly 2,000 years ago they were using paper made by hand, fashioned by processes used all over the world until comparatively recently. The raw materials used by the Chinese were generally obtained from the mulberry tree, rags, hemp, willows, and similar sources.

Vegetable Fiber Papers

Paper first made its appearance in Europe in or about the 11th century. (There is in existence a manuscript on cotton paper attributed to that century). There were certainly rag-using paper mills in Spain by 1085.

Though the first known British paper mill was erected about 1490, paper was available from foreign sources. It was then a luxury article.

Paper is made from cellulose derived from vegetable fibers, and in early days the raw material was

obtained from textile waste or rags. High grade papers are still made from linen or cotton, but the bulk of present day production has vegetable pulp as its basis. This is obtained from the treatment of wood or various grasses.

Esparto grass papers date from experiments made in 1839, and by 1861 its use was established. Mechanised wood pulp made by machine methods alone was patented in one process in 1866, while chemical wood cellulose was introduced between 1880 and 1890.

Watermarks are frequently important. These probably originated in Italy in the latter part of the 13th century, the earliest known, dating from 1282.

In modern processes watermarks are placed on the wet pulp of paper in manufacture by a dandy-roll, a woven-wire, gauze-covered skeleton roll having the watermark device fastened to it. The impression on the wet pulp causes a thinning by fiber compression corresponding to the design.

This historical information can sometimes be of great value.

The 1842 edition of Tennyson's *Morte d'Arthur,* a collectors' item, became of interest some years ago when there seemed to be more copies available than seemed reasonable. When copies were microscopically examined, the paper revealed the presence of esparto grass fibers. This meant a paper had been used which certainly did not exist until well over ten years after the edition was published.

When investigations are made, dates in earlier times must to some extent be arbitrary. The expert endeavors to verify his material by means of every available technique, for possible pitfalls are many. Of course, paper alone is not the deciding factor in dating an ancient document.

Chemicals Change Colors

In testing the material from which paper is made, the primary danger is that — excluding visual examination of the surface—a small portion of the item must be used and perhaps damaged or destroyed.

Chemical methods using reagents (chemicals used for examining or measuring other substances) will cause the different types of fibers to take up characteristic colors.

Some of the types of reagents generally used are listed in the chart on the next page.

Other tests can be made, but these depend on a sufficient sample. This means the nature and proportion of the mineral matter present, for example, can be determined by burning a weighed fragment of paper, and making a qualitative ash analysis.

Such exact techniques may not always concern the forensic chemist, but when they do his examination of the paper's origin, loading, coloring, sizing, and such matters will take in microscopic, microchemical, and even spectroscopic tests when necessary.

Should a specific question of col-

Type of fiber	Reagent used	Color on staining
Linen and Cotton	Iodine	Light to dark brown
Straw, Esparto, Chemical wood	Iodine	Almost colorless to light brown
Mechanical wood	Iodine	Yellow to brown
Linen and Cotton	Zinc-chlor-iodine	Strong wine red
Straw, Esparto, Chemical wood	Zinc-chlor-iodine	Blue
Mechanical wood	Zinc-chlor-iodine	Yellow

or arise, the visual or photoelectric colorimeter may be used. In expert hands, the colorimeter is sometimes useful in quantitative phases of investigations into poisons and in the identification of dyes, but its use is not comprehensive.

Old documents can present characteristic brown mold marks. When genuine, these marks are translucent after wetting with water. They regain their original appearance if dried out naturally. The water test, which is harmless, will not result in translucency when mold marks are made by other than natural means.

The discoloration produced by age on paper is generally a process of oxidation brought about by microscopic test. The substances used to simulate aging—coffee, tea, permanganate of potash, extract of tobacco, woodfire smoke—are never even in their deposit. Mere checking with a hand lens reveals many of the artificial processes.

Spurious documents have often been treated to achieve a superficial impression of age. One method is to create the illusion of folds supposedly as old as the document. This is done by mechanical means or hand pressure. This document may have been rubbed on a grimy floor, or smeared and impressed with dust. Such "antiquing" is quickly distinguished by microscopic examination, the disturbed fibers or embedded dirt grains being particularly noticeable.

A forged watermark is an addition to the paper. One of the sim-

plest and most common methods used today is the imposition by hand or machine of a watermark made on paper with an oily substance which, in unaided visual study, seems apparently genuine.

When the suspected paper can be dealt with directly, such a form of watermark is removed wholly or in part by ether. If the document must not be directly touched, ultraviolet light examination reveals the true nature of the watermark.

In historical development inks have a fairly well-defined picture. Probably the oldest are carbon inks. We have a record of an Egyptian inscription on a bowl in carbon ink approximately 5,000 years old.

Soot From Pots

One expert suggests that in ancient times this ink was made from soot removed from cooking vessels. Carbon ink has been proved to be an almost permanent medium.

Iron-gall ink came into use somewhere about the first century of the Christian era. A mixture of ferrous sulphate, with nut-galls, and gum, it was certainly the normal ink in Roman times.

The use of logwood as a color-improving ingredient in iron-gall ink was known as early as the middle of the 18th century. A hundred years later logwood was in use with potassium chromate, and without an iron compound, as a writing material.

Though colored inks were known to the ancient Egyptians, who used red ochre, and to the Romans, who used red and green materials, the first aniline dye ink came in 1856. This was mauve. Aniline blue came in 1861.

The so-called "solid inks" used in ball-point pens are in fact a thick suspension of dye in, usually, a drying oil. Many of the early "solid inks" tended to smear, even some time after application. Today, more than one ballpoint ink is in use which writes perfectly dry and does not smear. This type of ink, in conjunction with the form of the writing tool, is a help to the forger. One advantage he has been swift to take is the ease of color matching.

Marking inks have been used for many centuries—their origin usually being in plant sources. The cashew nut, with a very ancient history, yields a juice which may have been one of the first marking inks.

A marking ink containing a reducible silver salt was patented in 1846. At present there is an invisible "uranium fluorescent" marking ink also made for laundry use, while a type of ball-point has been used for marking purposes.

Stamp pad and similar inks dry by absorption. They usually contain a percentage of dye in glycerol solution, while the modern typewriter ribbon inks do not differ very largely from those used in printing.

Secret or "invisible" inks have a confused and elaborate history. However, their use as they affected

the investigator is much smaller than popular fiction suggests.

Pliny describes the use of milk, and other materials in many forms have been reported. The variety of secret inks takes in a great many liquids. The most general are water, fruit juices, saliva, urine, and most soluble salts in dilute solution.

Detection is most frequently achieved with ultraviolet or infrared light, heat, iodine, or sulphate vapor, invisibility being penetrated by the simplest laboratory routines.

Other inks sometimes used in older documents are the vanadium inks in use about 1885, and a coal tar product, nigrosine, an early type of dye ink derived from aniline hydrochlorate and dated about 1892. The ordinary water-soluble inks have a history going back not much more than 20 years.

In examining inks and their constituents, chemical reagents are used when a minor interference with the document is permissible.

Washable Inks Dissolve

When the ink itself is under test, the greatest care is essential. Only a portion of a letter is necessary when using a reagent.

Testing water solubility is the first step. A drop of water on a small piece of filter paper can be pressed on to the ink, which, if carbon, will make a black stain on the paper. Washable inks tested in this manner rapidly dissolve.

Oxalic acid solution will bleach iron- or nut-gall ink. Any addition of logwood will cause a violet or pale orange reaction, depending on the presence of potassium chromate or copper sulphate. Carbon or nigrosine inks do not react. Sodium cyanide solution is sometimes used. It is an unsafe reagent and has no effect on dyes in inks but reacts with iron. Nigrosine ink, unchangeable with several reagents, will turn brown on the use of hydrochloric acid and sodium hydrochlorite. These last bleach iron and logwood inks, but vanadium inks are unaffected.

In general, dilute hydrochlorate acid, dilute sodium hydroxide, and a solution of sodium hydrochlorite are probably the most widely used in testing inks. For testing ballpoint inks, a chloroform solvent used with filter paper is of considerable value.

A test is often made with a finely pointed orange stick, the reagent being touched on part of an inconspicuous serif.

In one examination, a document believed to be of considerable age was questioned. The examiner was surprised to find traces of metal dust in an ink supposedly some 400 years old. The writing had been expertly carried out, and the general simulation excellent, but the metal dust, however, was found to be aluminum. The man who had forged the document was seized. It was learned that his brother was filing an aluminum casting in the same room where the document was being prepared.

The date of pens may also be

noted. Quill pens were in use from unknown times until the beginning of the 19th century, when they were often tipped with a metal cast. The first steel pens were made in Birmingham, England, about 1780.

A quill reservoir pen, called a fountain pen, was invented in 1819. By the 1890s perfected forms of these pens had come into wide use in Britain and the United States, with iridium tipped gold nibs. The ball-point appeared about 1940.

Pencil Seldom Found

The pencil, however, is seldom met with in criminal investigations work, but it cannot be entirely overlooked. There is little individuality in the pencil itself. The so-called lead pencil, in which graphite is used, dates from the 16th century. Before that lead or a lead alloy was used. Modern pencils are a mixture of graphite and clay.

Partial interference with a document is the most commonly encountered practice.

When the suspicion of document alteration exists, the first step is a visual check. Paper slanted under a strong light will reveal mechanical erasure. There is also the elementary step of holding a document before a strong light so that thin spots, indicative of mechanical erasure, can be seen. A hand lens is useful in detecting chemical erasure, particularly on papers with a high finish. The binocular microscope is also useful.

In chemical erasure, inks are bleached out of sight, but the residues remain undisturbed. An ultraviolet light photograph, with the correct plate and filter, will show the erased material.

Both chemical and mechanical erasures can be restored in most cases by a nebulizer which delivers a fine spray of reagents, harmless to the surface of the document. The intense chemical reaction will restore the erased writing.

On mechanical erasures of pencil marks one expert says: " . . . although writing immediately after erasure may not be visible, it may not have been removed completely . . . a portion may remain covered up by loose fibers of the paper that have been disturbed by the india-rubber, or on the inner surface of fibers that have curled up, and after a time the former partly regain their normal position and the latter uncurl . . . revealing the writing."

In what appears to be complete erasure, particles of graphite left deep in the paper may reveal their presence under ultraviolet light.

Mechanical erasures of inked writing are unusual because of the ease of purchasing efficient chemical erasers. The success of such forms of erasure is that their existence is not usually suspected by the layman.

Alterations by means of additions are another variety of forgery. Investigating the overall appearance of the document is the first step in the examination.

The appearance of the document as a whole is the main consideration.

The placing of the writing or figures and the crowding or attenuation of wording or figures in relation to the bulk of the writing are two things which must be noticed. Usually simple microscopic c h e c k s are enough to verify any suspicions.

In one case, an *o* changed to a *g* by the addition of a tail was quickly v e r i f i e d by a photomicrograph which revealed the addition of the tail both as a stroke and by a clear contrast in two types of ink not visible to the naked eye.

Dated Within a Week

The age of writing is determined by a study of the ink against samples from a collection of standards. Recent documents can be dated almost to the week of their execution.

One of the first things that indicate added or substituted handwriting is the behavior of a written stroke across a fold. The original writing is compatible with the rest of the page, but an addition— in ink or pencil—shows under magnification where it crosses a fold. The already disturbed or broken paper fibers take up the added stroke by flawing on the fold. A downward stroke will bulge or fluff at the exact fold, though the parts of the stroke above or below the fold will not.

Burned or charred documents require a special technique. The first step is to protect the delicate material.

A diluted lacquer is carefully sprayed over the fragments until the material has sufficient strength to permit examination.

This is made by various types of illumination, and photographed with infrared light. Chemical fuming methods are successful in some cases, and, by and large, burned documents can be read.

One of the curious illusions among those who commit certain crimes is their belief that paper burns easily. In the form of loose sheets it does, but in bulk it is resistant to fire. Burning will take place at the exposed edges, but paper solidly stacked seldom does more than brown under intense heat. Even deliberate destruction is sometimes ineffective. There is the case of a check that was burned in a grate and broken up with a poker. It was treated with lacquer, almost completely reassembled, and—under strong oblique light—its ink-written wording was visible.

The study of handwriting is correctly known as graphology. The word, however, also unfortunately refers to the purported art of judging one's character from his handwriting.

The conditioned reflex pattern of a person writing a document is more or less spontaneous. He is trained in the elements of handwriting in childhood, his training, habits, and nervous system condition his style of writing. The final pattern achieved is repetitive, and writing is highly personal.

Modifications or temporary distortions can manifest themselves

(in speed, stress, etc.) but the writing style as such remains reasonably consistent in form.

It is possible for identity to be given away in the writer's word-forms. For instance, the copies of two letters from the same writer can be broken down until a style of composition is found, in which the writer's personal technique emerges: word structure, phrasing, clauses, and other facets are indicative. Though not conclusive in any way, it is not impossible to determine whether the same person can have written two particular letters, by this method.

The national systems of handwriting, maintained by some authorities as being characteristic, are of less importance than the individuality of the handwriting concerned. To say loosely that a handwriting style is Teutonic or Gallic is not a scientific definition. A scientist may justifiably say it shows Teutonic tendencies, but will hesitate to commit himself to anything more exact.

The Anonymous Letter

A court, hearing evidence, was told that the author of a letter was French, middle-class, and young. In fact, however, he was the English son of an Armenian father, educated in the United States and over 50 at the time the letter was written.

The anonymous letter can also be investigated. Here the unconscious habit of handwriting is directed into channels requiring conscious direction for purposes of disguise. Sometimes highly elaborate precautions are taken against possible detection.

An anonymous letter-writer adopted a method of block-writing his letters using his left hand although he was normally right-handed, and printing the wording upside down to hide his identity. The means used were instantly apparent on examination, and though certain characteristics were disguised, a comparison with the subject's regular right-handed block-writing, gave comparable clues in the angles, curves, letter, and word spacing.

Identifying Typewriters

Though the first patent for a typewriter was granted in Britain to Henry Mill in 1714, a practical model was not developed until 1867. The Sholes and Glidden machine appeared in 1874. Today's machines are largely made by a few big manufacturers, and though the variations are many, the principles generally the same as in the earlier machines.

Many authorities, such as the F.B.I., carry files of typewriter faces. A study of several well-known makes shows how the type faces are identifiable, for type faces of the same size and font will vary between maker and maker.

Spacing and numerals receive early attention in examination. The spacing is measured, while the numerals 2 to 9 will be found to vary not only between makes of

machines but between different models of the same make.

The hand lens, the microscope, and measuring devices are important in investigating the slant of characters, angles, alignment, and footing (when a character strikes heavier on the right, the left, or at the bottom).

Dirt in the Keys

Individuality can be determined by studying wear, defects, or accidentals—ribbon faults, dirt in the letters, and so on. The imperfections in a well used machine are significant and often unusual.

It is said that absolute similarity in two typewriters stands at odds of one in 3 trillion. The odds may be questionable but the likelihood of absolutely similarity in two used machines may be ruled out.

A test was once made when a used machine was handed over to an expert mechanic who was given a free hand in time and money to find a duplicate model and artificially produce every individuality of the original. Despite considerable care it was found, after much work was done, the two machines gave samples which an examiner had little difficulty in differentiating.

In operation the typist imparts individuality which is significant. Typewriters adjust themselves swiftly to their users, the machine belonging to a slow, uncertain typist loses its pattern when taken over by a fast touch typist.

A pattern of style will sometimes emerge in a typist's work. This pattern can be useful in identification, even in the electric machine where the more characteristic signs may be partially or wholly absent. Spacing between the letters may by the smoothness or lack of it in the operator's touch have shown discernible differences.

The first and most useful weapon against the forger is the low power stereoscopic microscope that enables the line quality of a forgery to be examined in enlarged detail.

The forgery, no matter how skillful, has to some extent a psychological inference. Quaver, uncertainty, hesitation, pen lifts, pauses, retracing—they are separately or collectively bound to appear in some form or another on the forged document.

The examiner's instinct will play a part in sensing a forgery or a forged part of a document.

It is possible he may be deceived by a perfect forgery, but a perfect forgery is really a contradiction in terms. A forgery is only perfect in the sense that it passes the scrutiny of the person it was intended to deceive and thus never reaches the expert for consideration. Under proper examination a forgery seldom passes muster.

The most skilful form of forgery is free writing, the method of drawing a copy by constant practice against the original. When the amount of forged material is very small it is particularly difficult to detect.

Currency forgery or counterfeiting is often marked by indifferent

workmanship, depending for success on the lack of suspicion, or pressure of work, on the part of the person accepting bills. Most forgeries are passed at busy times. The man whose business is the handling of money is not generally deceived by forgeries.

Genuine Forgery

Forgeries which do pass the expert have to duplicate many protective processes—special paper and watermarks, design, and color.

Stamp forgeries are less common than the use of genuine stamps from which cancellation marks have been removed. Such interference is often seen with the use of a lens, particularly when an erasive has been used. Insurance stamps, cancelled by hand-written dates, are treated with bleaches or washes for reuse or resale but the sensitive color inks used in making the stamps are often difficult to tamper with. When the tampering has been successful, the results are soon to be observed by examination.

A combination of real ability and the knack of making forgery pay was shown by an engraver who turned out many thousands of very good bogus stamps, each one indelibly marked on the back *forgery*. These were sold to collectors in many countries, their maker contriving an excellent living for many years.

CORTISONE LINKED TO CATARACTS IN THE EYE

THE PROLONGED USE of cortisone has been linked to the development of cataracts in the eyes of arthritis patients. In a study by four University of Michigan physicians, 14 out of 38 patients who had taken moderate and high dosages of corticosteroids for over a year for rheumatoid arthritis experienced changes in the lens of the eye.

The changes, described as "discrete, posterior subcapsular cataracts," were areas of small opacity producing minor symptoms and little reduction in the ability to see. The conclusion of Drs. Conrad L. Giles, Gordon L. Mason, and Ivan F. Duff, and James A. McLean confirmed earlier reports of an association between the drug and cataract formation.

No similar lens changes were observed in a group of 24 comparable arthritics who had never received corticosteroids. Modeled after hormones produced by the adrenal cortex, the outer part of the adrenal gland, the corticosteroids included cortisone, hydrocortisone, and their derivatives including prednisone.

The amount of drug and the length of time it was taken appear to be the major determining factors.

The physicians also reported that out of 12 persons with chronic bronchial asthma, two who had taken corticosteroids in moderate amounts for more than four years were found to have the same type of cataracts.

"Every effort should be employed to keep chronic systemic corticosteroid administration at minimal-dosage levels," the physicians concluded.

SCIENCE NEWS & VIEWS

by Ellis Mott, Editor

SCIENCE TOYS, which we featured in our November and December issues, are often thought of as the product of the Atomic and Space Age. According to an article in the British publication *New Scientist,* there were rather advanced science toys in the 1700s. And at the beginning of this century a German firm (run by a Frenchman, George Carette) put out a 200-page catalogue of science toys.

The modern-day kits of related equipment for the study of air, electricity, magnetism and what-have-you are not new. Carette and Company sold a number of boxes of apparatus for experiments. And the perennial train sets were made in Germany over a hundred years ago.

There were advanced sets with working models of Cooke's tubes for demonstrating the properties of cathode rays. Carette even had a box of experiments of "des rayons Rontgen" (x rays). Boxed sets of instruments were listed in the Carette catalogue for the study of light, sound, chemistry, and mechanics.

The science toy industry just before World War I produced some toys of lasting value. Collectors of antique science toys have fascinating examples of how well these toys can be made. In this age when plastics make mass production at low cost possible, it is to be hoped that these modern methods can go hand in hand in making science toys of a better quality.

In keeping with *Science Digest's* interest in science toys, we will continue to publish descriptions and pictures of new products in this field throughout the year.

From a commercial point of view, we can point to the fact that more than 9 million high school students in the United States are taking science courses. That is a tremendous group who are looking for good quality kits, apparatus, devices and, broadly speaking, "science toys."

Students and teachers who are reading this column might like to express their ideas on what is needed in the area of "science toys." If we receive any specific suggestions for kits, experiments, or products of interest to science students we would be glad to pass the ideas along to the toy manufacturers.

* * *

Scientists should become space travelers as soon as possible. That's one of the many recommendations that a report by the Space Science Board of the National Academy of Sciences proposed as a national New Year's resolution. In a volume nearly two inches thick, the scientists called for the training of scientists in astronautics so that the first space flight to leave the terrestrial domain would have a trained scientist aboard, and could benefit from the contributions that he might make.

The fat report, loaded with recommendations and findings, also called for the top priority on man's effort to find life outside the earth. Leading United States biologists said there were many reasons why the search for life outside the earth was most important. They said that the key to life on this earth, that is to say better life on this earth, would most likely be found in extraterrestrial investigations. There is no reason (by logic) that other life cannot be found. There are at least 10^{18} (10 with 18 zeros after it) systems outside the earth to choose from. "Life may be almost as common in nature as a whole," they figure.

And where would they look first?

Mars offers a great opportunity in the near future that man might venture there. What scientists find on Mars will be a great key to the universe. "If life does exist there (or has in the past) then it is evident that in any given solar system there is every reason to believe that life must occur . . . in the staggering number of comparable planetary systems."

The reason for exploring Mars or other planets is not the same as that classically recorded when the mountain climber said the reason for scaling the peaks was "because they are there." Looking at Mars will provide a deeper insight into our life here on earth. It will answer many baffling questions: If amino acids, the building blocks of our protein, are involved on Mars, are they the same forms we know now? Is the energy transfer system based on phosphorus, as in earthly creatures? What information storage and reproduction systems are involved? What has been the course and mechanism of Martian evolution?

The report has many other implications. Much of it will take some time to digest. It was months in preparation after the six-week study last summer at the State University of Iowa. The National Aeronautics and Space Administration (NASA) asked for the study and it was held under the auspices of the National Academy of Sciences—National Research Council.

* * *

Other groups are doing a lot of thinking and planning, too. The Institute for Space Studies in New York City at Columbia University is a part of the theoretical arm of NASA. Bright men of science, under the very able supervision of Dr. Robert Jastrow, the Institute's

director, recently discussed another planet, Jupiter.

Jupiter is the largest planet of our solar system. It has a mass 318 times that of the earth, and a diameter of 88,000 miles. Its center may be a rocky core about the same size as the earth's, but there is a tremendous surrounding envelope of hydrogen and helium, probably in liquid and *solid* form. The atmosphere of Jupiter is made up of ammonia, methane, hydrogen, and helium.

The difference between Jupiter and the earth is that the hydrogen and helium make up about 98 percent of Jupiter and account for very little of the earth. Why those two gases didn't escape from Jupiter cannot be determined as yet.

It will be a while before man can go there and take a look. At the speed of today's rockets and spacecraft, it would take several years to reach the giant planet. Jupiter is in orbit around the sun *outside* of the earth's orbit, the velocity of escape (25,000 miles an hour) is not enough. A Jupiter-bound spacecraft would have to be launched in the same direction as the earth's orbital motion and then wisked off the ground at more than 32,000 miles an hour. Assuming that velocity, the Jupiter flight would take 2.7 years.

Radio astronomy in 1955 found that Jupiter is one of the strongest sources of radio waves in the heavens. Because some of the radio emissions are similar to those produced by the earth's Van Allen belts, it is thought that Jupiter may have its own belt of plasma, circling it like a huge doughnut . . . and several times as intense, held in by an extremely strong magnetic field. In fact, radio astronomers think that Jupiter's magnetic field is 100 times stronger than that of the earth's.

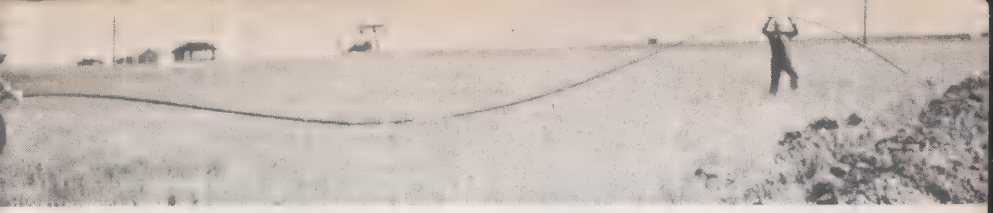
The scientists at the Institute for Space Studies, talks on Jupiter pretty much threw out the earlier-held idea that the radio emissions were caused by tremendous lightning storms that flash around in Jupiter's atmosphere. Some of the scientists attending the talks estimate that the temperature on Jupiter's surface is about 1000°F, which makes the giant planet a pretty hot place.

* * *

And so goes the changing tide of science information.

Many things are no longer thought to be as they were only 15 years ago. It has been said that more knowledge in science has been determined in the past 20 years than had been amassed through recorded time. That's hard to believe. It's hard to conceive. It means that we are living in fascinating times as science unlocks more of nature's secrets than ever before.

It is the continuing challenge to the editors of *Science Digest* as we attempt to digest and report new science information for you each month.



Delrin acetal resin pipe can take the place of rigid metal pipe in some applications. It is also flexible enough to be bent through a complete circle in 100-foot segments. However the manufacturers do not recommend its use under excessive bend stresses.

New super-smooth metal substitute

by Dan Brigham

Who needs a pipe as smooth, inside and out, as the barrel of a fine shotgun?

Oil men do—because in the field operation of high-paraffin oil lines deposits build up inside the pipe to the point where ordinary pipes have to be steamed two and three times a month particularly in the winter. Smooth pipe simply doesn't give deposits anything to hang on to.

One of the smoothest pipes available is Delrin acetal resin pipe, the DuPont Company's newest engineering plastic material, designed to replace metal pipes in scores of applications. One day soon it will go into domestic water lines . . . if only for its apparently infinite resistance to internal build-up of calceous deposits.

But Delrin is not only smooth. It is so strong it hasn't broken down in prolonged oil field operations; it is so light, one man can easily carry 100 feet in 20-foot sections; it is so easy to handle that a three man team, working under the worst conditions in the field, can lay up to 800 feet an hour—with hermetically sealed joints.

The pipe can also take boiling salt water under pressure, burial with no corrosion protection, solvents, and surge pressures year in and year out with no failures.

Delrin, essentially a highly crystalline thermoplastic polymer based on formaldehyde, has yet to show any axial "pattern" failures even when tested to destruction at pressures above 600 psi (pounds per square inch).

Fatigue failures, when they finally occur under surge pressures of 125 to 325 psi on a two-inch by 100-mil pipe, usually show only after months of testing. Even then the failure is usually a pinhole-type "flaw," often so small that the test

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sample has to be resubjected to pressure to reveal its exact whereabouts outside the test tank.

The engineers who developed Delrin plan this year to campaign for building code acceptance of their product on domestic gas lines. Engineers in the greater New York metropolitan area "doubted very much" that they would encounter any difficulties.

One reason is that the extrusion, die-cast pipe varies less than three mils in wall thickness under standard production controls. Even finer tolerances have been achieved, when required, though usually only for testing procedures.

Another reason is that Delrin's inherent resistance to all solvents—acid, alkaline, and the hydrocarbons—even at temperature range extremes from —40°F. to 150°F. also weighed heavily in its favor. Perhaps the pipe's most attractive feature for the safety-conscious building code experts is the simplicity—and durability—of Delrin joining procedures, which actually produce a welded connection that is an integral part of the assembled pipe line.

Using a hand-operated heating tool, sections can be coupled in a 35-second cycle—give or take another five to ten seconds under extreme weather conditions outdoors.

The operator simply "melts" a thin film on the inside and outside surfaces of the sections to be coupled, presses them firmly together under hand pressure, and waits a few seconds for the molten resin to solidify. Tensile strength and

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Dan Brigham, Military Affairs Editor of the *New York Journal American* and a frequent contributor to magazines on the scientific aspects of Defense Department research and development, holds an electrical engineering degree from the Technische Hochschule, at Munich, Germany. He also studied chemistry at Kings College, Cambridge, England, and did graduate work at Electro-Technique College, Grenoble, France.

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bending stress tests show that the integral joint is considerably stronger than the pipe itself. (The pipe is sold in 20-foot lengths with coupling attached to one end.) Standard couplings are available to permit linkage of Delrin to steel pipe.

Simple to Make Repairs

Repairs, when needed because of impact breakage, or, more frequently, abrasion in surface installations when unanchored pipe "snakes" due to surge, are equally simple to make. Damaged sections are simply cut out, and new lengths installed with chamfered ends to simplify fitting. (The pipe's 10,000 psi tensile strength and low coefficient of linear expansion (4.5×10^{-5} in/in/°F.) are sufficient to insure against line breakage through mechanical stress.)

A feature bonus confirmed in service is Delrin's low friction loss in liquid or gas transmission. Fluid

All photos © E. I. Du Pont de Nemours & Co.

1. Coupling sections of Delrin pipe is relatively simple procedure, even under difficult oil-field conditions. Before joining the pipe ends workmen clean them of mud.
2. Ring clamps are placed around the outside of the pipe to assure alignment.
3. The outside of the pipe and the inside of the coupling are melted with a hand-operated heating tool powered by a portable generator or plug-in power source.
4. After heating, the pipe ends are quickly joined, and held together for 10 seconds for the molten resin to solidify.
5. Sections can be securely coupled in 45-second cycle—give or take five to ten seconds under extreme weather conditions. A two or three man crew can lay 600 to 800 feet an hour.

flow rates, in fact, are so high it is often possible to go to a smaller size with Delrin than would be feasible with metal.

DuPont researchers credit this to two factors: the smoother wall surface that cuts down friction loss and turbulence; and a larger inside diameter, size for size, possible because of the predictability of wall thicknesses in die-extrusion production.

Laboratory tests have shown, for instance, that a one-inch gravity-fed, 100-foot Delrin line emptied a test tank in precisely the same time as a one and one-half inch metal pipe of the same length.

Available with the pipe will be standard couplings, fittings and adaptors to fit any architectural or construction need. For, though flexible enough to be bent through a complete circle in 100-foot segments, the makers do not recommend its installation under excessive bend stresses, particularly in domestic installations.

More Testing Due

The pipe will not be recommended for the do-it-yourselfer until much more testing has been completed—even though the rigid pipe itself presents no handling problems. That has been amply demonstrated in scores of installations in the oil country, where case histories daily demonstrate why Delrin acetal resin has caught the attention of the petroleum industry.

ASPHALT EATING BACTERIA HELP BALANCE NATURE

ASPHALT EATING BACTERIA have posed a challenge not only to road-builders but to microbial chemists too.

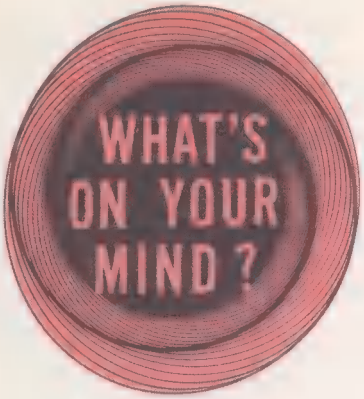
"These tiny organisms eat asphalt, using it as a food supply and modifying its physical properties. This is a problem of economic importance since asphalt is used for a variety of purposes such as road surfaces, roofing, waterproofing, and pipeline coatings," according to Prof. Richard W. Traxler of the University of Southwestern Louisiana.

The asphalt-eaters, however, have finicky taste buds and prefer certain types of asphalts, Dr. Traxler pointed out. Builders can use this fact to advantage by avoiding the bacteria's favorite asphalts.

"Also, this preference by the bacteria for certain asphalts will make it possible to determine which compounds are being consumed by the bacteria. That is, the bacteria may be used as an analytical tool to learn more about the chemical composition of asphalt.

"It should be pointed out that many years of work will be required before we know all the answers to such questions as to how to control this action or if commercially important products can be obtained from bacterial action on asphalt.

"This type of action is not unique in nature, since it is one of her methods of establishing a balance. Otherwise, we would have overabundant quantities of such materials accumulating in our natural environment."



ARE YOUNG SCIENTISTS LESS CREATIVE THAN ARTISTS?

A British psychologist has gotten some test results, and he feels if they are "only partly true" they have disturbing consequences for science. Dr. L. Hudson of the psychological laboratory at the University of Cambridge, England, using a test developed by Dr. Jacob W. Getzels and Dr. Phillip W. Jackson of the University of Chicago, has compiled results that confront him with the following alternative interpretations:

Historians and specialists in English-literature are more creative in their style of thinking than physical scientists.

That most creative students dislike science and turn to the arts instead.

The psychologist writing in the British scientific journal *Nature,* stated "one would not expect to find . . . that unpractical young historians are significantly better than practically minded young physical scientists at thinking of uses for everyday objects" as the creativity test he used in the study has suggested.

The test results tell nothing about which students will eventually do original work.

Earlier studies have shown that there are persons who are successful academically, whose intelligence quotients are relatively low but who excel in so-called "open-ended" tests of originality. Such a test would contain questions like: "How many uses can you think of for each of the following objects?"

Persons who score high on those tests but rank comparatively low on intelligence tests are classified as "high creative." Persons who score low on open-ended tests of originality but rate high in intelligence are designated as "high intelligence quotient."

According to *Nature,* the former are more likely "to express unusual attitudes; to have more liberal, non-authoritarian views about politics and school life; to show emotional involvement in their opinions; to say that they are unhappy at school; to have a broad rather than narrow range of interests and hobbies; to choose unusual themes for drawings and include people and violence; to make errors in doing the intelligence quotient test; and so on."

The one "unexpected" result of Dr. Hudson's tests was that all of the personal differences were overshadowed by the choice of curricu-

lum in distinguishing between the two thinking styles.

According to his findings from a study of 95 English schoolboys, those specializing in history and English literature were found to be strong on the originality tests and relatively weak on intelligence ones, while those specializing in physical science were the reverse.

Students majoring in the classics, modern languages, and biology seemed to fall in between those two extremes, the psychologist noted.

Dr. Hudson concluded that, "although there are many individual exceptions (the findings) do suggest that young physical scientists tend to be less intellectually flexible than young arts specialists and more restricted emotionally."

DISPUTE TALES OF CHILDREN RAISED BY WILD ANIMALS

The question of human children being raised in the wilds by wolves or other animals was again brought up when *Midway,* a magazine published by the University of Chicago, reprinted two classic articles on the subject of feral, or wild, children.

The first article is "The Wolf Boy of Agra," by the late William Fielding Ogburn, professor of sociology. Prof. Ogburn investigated reports of how an Indian child named Parasram was reared by wolves. After examing the boy and talking to all the people connected with finding him, he concluded that "I found no evidence that this 'wolf boy' ever saw a wolf."

Prof. Ogburn did not feel that the wolf boy story was a deliberate hoax, but rather a series of misunderstandings. "While my hunt for a wolf boy was not successful as a little journey into a land where myths originate, it was successful in showing how a myth began."

In commenting on Prof. Ogburn's article and on the entire subject of feral children, Bruno Bettelheim, director of the Sonia Shankman Orthogenic School for the education and treatment of severely disturbed children stated, "I have been convinced that most of the so-called feral children were actually children suffering from the severest form of infantile autism."

Autistic children have completely shut themselves off from the outside world. "Some acquire the ability to speak, while others remain mute," Dr. Bettelheim said, "but language is not used to convey meaning to others. The over-all behavior is governed by an anxiously obsessive desire to maintain sameness."

Dr. Bettelheim pointed out that the actions of some of the so-called wolf children closely parallel experiences he and his staff have had with autistic children at the Orthogenic school. The similarities were "so great and so unmistakable that no other conclusion seemed possible." Severe infantile autism, he states, "is accountable without a history of being reared by animals."

"Many times," he states, "when we have described the behavior of some of our extremely autistic chil-

Wide World

From time to time stories of children raised by wild animals come out of India. One of these so-called "wolf children" was Ramu, a crippled nine-year old, who drank only by lapping with his tongue.

dren: how they could not bear clothes but would run about naked, how they did not talk but could only scream or howl, how they ate only raw food, how they would bite us so often and severely as to require frequent medical treatments—even persons quite familiar with disturbed persons would react with polite or not so polite disbelief. But later, when they met these children, their doubts changed to complete belief, so that they would have been willing to believe almost anything told them about the children or their pasts."

Dr. Bettelheim believes that autistic children lost or abandoned in a place like India would be thought to have been raised by animals when found later by persons who knew nothing of their background.

This interpretation of the origin of their behavior, says Dr. Bettelheim, springs from two different psychological needs: "First, in our narcissistic unwillingness to admit that these animal-like creatures could have had pasts at all similar to ours (the same narcissim which revolted against the theory of evolution) and, second, in our need to understand and explain (the more unusual, the less acceptable a phenomenon, the greater our narcissistic need of an explanation). Perhaps, too, the more revolting the behavior, the less we wish to devote much thought to it, explaining it by an emotional reaction or in such simple form as to require no further thought."

"Some of these (austistic) children," Dr. Bettelheim writes, "on seeing animals respond as though they had found a dear, long-lost friend. One girl, for example, became extremely excited on seeing a dog; she showed a strong desire to run toward it and cried or howled like an animal, particularly like a wolf.

"She fell on all fours, jumped like a dog with her head down, and made biting gestures. Now, had we believed in the feral origin of this girl—whose total life-history, incidentally, is well known to us—we would probably have been convinced that, on seeing that wolf-like creature, she was filled with mem-

ories of her happy times among wolves and was reverting to what she had learned from them."

THE INSPIRATIONAL VALUE OF SCIENCE FICTION

Arthur C. Clarke, winner of the Kalinga Prize for the popularization of science which is awarded by Unesco, has come up with a vigorous defense of science fiction. Clarke is best known as a science fiction writer although he has written a great deal of nonfiction science including his now famous proposal of 16 years ago, for the development of communication satellites. He stated that many scientists still look down on science fiction.

As to the part that science fiction plays in the popularization of science, Clarke thinks its chief value is inspirational rather than educational. "How many young people have had the wonders of the universe first opened up to them or have been turned to scientific careers by the novels of Verne and Wells. Many distinguished scientists have paid tribute to the influence of these great masters; and a careful survey would, I believe, reveal that science fiction is a major factor in launching many youngsters on a scientific career."

Clarke describes science fiction as, pre-eminently, the literature of change. "What we science fiction writers call mainstream literature usually paints a static picture of society, presenting, as it were, a snapshot of it frozen at one moment in time. Science fiction on the other hand assumes that the future will be profoundly different from the past—though it does not, as often imagined, attempt to predict the future in detail. . . . By mapping out possible futures, as well as a good many impossible ones, the science fiction writer can do a great service for the community. He encourages in his readers flexibility of mind: readiness to accept and even welcome change—in one word, adaptability. . . ."

WRITER CITES ABUSES OF MASS TESTING

A person's chances of being considered a mentally healthy employment prospect with sound he-man qualities increase if he likes snakes, chasing bandits in a sheriff's posse, and reading detective stories. His chances wane if he likes playing bridge, visiting art galleries, and reading poetry.

This is among the conclusions of Martin L. Gross, education writer and researcher who has written a critique called *The Brain Watchers* on what he considers the abuses of psychological testing for employment and academic guidance purposes. Gross charges that such tests put a low premium on talent while preferring conformity, conservatism, and lack of creativity.

Gross cites the rejection of tested applicants on the ground that being highly talented, they would consider their associates stupid and thus would cause "trouble."

Destroying enemy satellites

by Albert Parry

CAN the Soviets shoot down our sharp-eyed Samos? Or our supersensitive Midas?

Can we bring down any of the Russian satellites that may be bothering us?

The Samos, whose name derives from the first letters of the phrase "satellite and missile observation system," takes photographs from its orbit 300 miles above the earth with a clarity that the human eye has at 100 feet. Samos also transmits this revealing film to us easily and completely. Its sister satellite Midas (missile defense alarm system) issues warnings to us when missiles are fired from the territory over which it orbits. The Soviets plainly dislike these spies in the skies. Occasionally Moscow mutters threats to shoot them down.

Yet, the Kremlin does not make too much of an issue over our Samos and Midas for the simple yet weighty reason that the Soviet Union has by now most likely developed—or at least is hard at work trying to develop—similar satellites with spying eyes.

The question then arises:

Can a satellite be shot down?

Ours by the Russians, or theirs by us?

No, say some Americans. Yes, insist other American experts.

"Samos is invulnerable," wrote Sanche de Gramont in his prize-winning 1962 book *The Secret War.* But Gen. Carl Spaatz, the retired chief of the United States Air Force, declared in the spring of 1961: "Reconnaissance satellites . . . will be vulnerable to attack by counter-satellites in any war of the future." The knowledgeable general said this just a bare few months after the first Samos was successfully launched at Point Arguelle, California. We were rejoicing, but the Russians were gloomy over our luck with the wondrous gadget in its orbit.

Counter-satellites in the future? But how far is this future? Can anything be done to bring a satellite down right now or at least fairly soon? Can a nonorbiting missile shoot down an orbiting rocket-capsule?

Last September 2, with more than a casual interest, a Soviet general remarked in *Krasnaya Zvezda* (*The Red Star,* the main daily newspaper of the U.S.S.R.'s armed forces) that "already now," and not in the vague future as Gen. Spaatz would have it, "foreign experts consider the task of destroying the earth's artificial satellites as realistic." The Russian writer, Maj. Gen. I. Baryshev, continued: "There has even been an attempt to 'bombard' artificial satellites with missiles." He described this non-Soviet attempt thus:

"In October 1959, from a B-47 bomber, at the height of 20 kilometers, a long-range ballistic missile was launched in the direction of an artificial satellite of the earth. The satellite was at the time located at a distance of 232 kilometers from the earth. The missile passed within six kilometers of the satellite."

To what non-Soviet attempt was the Soviet general referring?

Experiment in Destruction

To an actual case on our American record, namely our experiment which took place in the vicinity of Cape Canaveral on October 13, 1959, when a B-47 carrier airplane rose into Florida skies to try and hit a satellite. The target was our own Explorer Six.

The plane had on board the Martin Company's Bold Orion, a two-stage missile. The Bold Orion missile was launched to follow a trajectory carrying it 146 miles into space. Its approach to Explorer Six was quite close—possibly only four miles short of its orbiting target. Bold Orion was programmed to fire out flares en route to facilitate optical tracking of it from the ground.

The satellite was missed by a small margin, but the feasibility of

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Prof. Albert Parry of Colgate University is the author of the well-known book, *Russia's Rockets and Missiles,* and is a contributing editor and regular columnist of the weekly magazine, *Missiles and Rockets.*

hitting and destroying a satellite was proved.

In fact, experts agree that it is easier to shoot down a satellite than an intercontinental ballistic missile. Not on the satellite's first orbit, to be sure. But after its initial appearance, when its subsequent path is known, and a multistage missile can be fired at it, if not from a ground installation, then from a plane, which means more maneuverability than a ground-based launcher.

In America two systems have been discussed as tentative antisatellite weapons: the Army's Nike-Zeus, more widely known as a possible antimissile missile; and Early Spring, a Navy proposal of 1960. In antisatellite activities, both would work on the same principle: A probe would be launched vertically in such a manner that it would reach the altitude of the target satellite. It would reach it with zero velocity, hover there until the satellite came into range, and then be detonated by ground command. Kill mechanisms that have been discussed by experts for such antisatellite shots are high explosives, but also, paradoxically, innocent looking steel pellets and even sand particles have been mentioned.

In this connection, Gen. Baryshev declares (in his Russian article entitled "What Is Anti-Space Defense" published last September):

"Researchers in the United States are investigating possibilities of destroying artificial satellites by creating, in the latter's path, clouds of sand, tiny bird-shot, and other hard particles."

As simple as that?

Explains Lt. Col. Nels A. Parson, Jr. of the United States Army in his book, *Missiles and the Revolution in Warfare:* "The velocity of the target will be so great that even the simple solution of placing material in its path will destroy it. Small particles would act like bullets, for the satellite target would hit them at velocities of thousands of miles per hour."

Orbits in Higher Altitudes

One effect of such attacks would be to drive satellites farther and farther into space, for in lower orbits the satellites' detection and destruction may become a comparatively easy task. Says Col. Parson: "Space-defense missiles may sound like the sheerest fantasy, but they may prove to be very effective against lower-altitude vehicles." When the target is orbital, it is "following a course that can be accurately predicted." Can it dodge the attacker? Not too well, Col. Parson argues: "It can deviate from orbital flight only for short periods of time, for maneuver requires application of power, and power will be very scarce in space."

Sources in Washington say that the antisatellite kill mechanisms so far discussed with any earnestness by our side are all nonnuclear. But Moscow views our intentions differently.

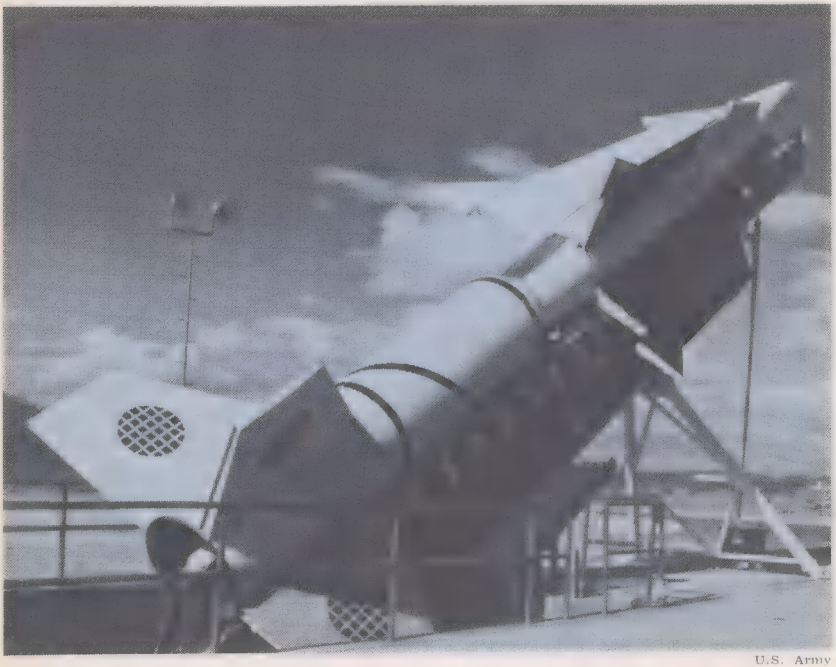
Gen. Baryshev insists, for typical

Soviet instance of such disbelief, that American experts do consider the use of nuclear explosions to hamper at least, if not destroy, other people's satellites. He writes: "Military specialists [of the United States] plan to use nuclear explosions at high altitudes to disrupt the functioning of spaceships' radio equipment. This, in their opinion, will cause breaks or at least 'bugs' in the radio guidance of the spacecraft."

But let us return to the counter-satellites predicted by Gen. Spaatz, also by Col. Parson when he wrote: "Novel and radical methods of neutralizing hostile space vehicles will come."

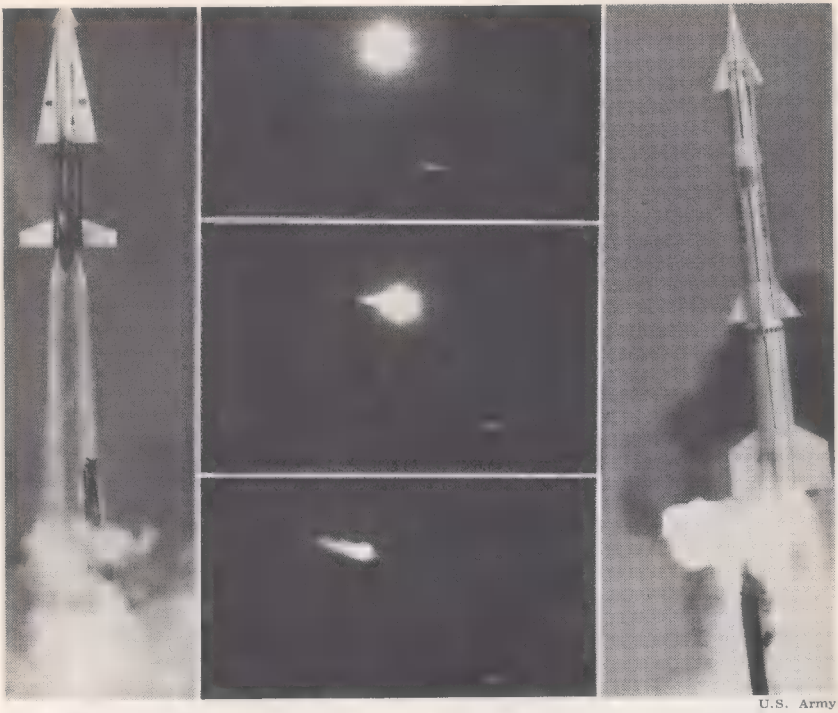
In recent months the world at large, but particularly the rulers of the Soviet Union, could not miss the potential importance of our Air Force program surrounded with some secrecy and unofficially known as Project Saint.

The name is a not-too-happy contraction of the two words, "satellite inspector." The program aims at the development of an interceptor satellite capable of locating and inspecting a probable hostile space-



U.S. Army

A missile launcher slowly lifts its deadly burden, a Nike-Zeus, into vertical take-off position. An antimissile missile, the Zeus may possibly become an antisatellite weapon.



U.S. Army

In a test firing, the target, ■ Nike-Hercules missile, left, is launched, followed by the launching of the interceptor, a Nike-Zeus missile, right. The center photograph shows the simulated explosion of the Zeus warhead, marked by the larger, sunlike bursts. The smaller, cometlike objects are the target missile. The distance between the burst and the target was measured electronically and found to be well within the destructive radius of the warhead actually planned for use in the Nike-Zeus missile.

ship. It was about Project Saint that Maj. Gen. Arthur C. Agan, Jr. wrote in his article "Aerospace Defense" in the *Air University Quarterly Review*, "Satellite inspection will be required to determine whether an object in orbit is a threat to the United States, since this determination will not always be possible from the ground and a serious threat could develop quite rapidly."

A Saint would make a rendezvous with its target satellite and inspect it electronically, that is by television. If found to be a threat, the foe satellite would be either neutralized by the Saint or destroyed right then and there.

"Project Saint is pointing toward an orbiting defense system," wrote Col. Parson in his 1962 book. And yet the world was somewhat puzzled when in December of that year Saint-I was abandoned as a project. The reason for the abandonment

was the realization that the very latest technological developments had practically by-passed Saint-I—had made it obsolescent even before its three-year-long development was complete.

In actuality, Saint-I was reoriented last December toward a more advanced system now known as Saint-II. Its main principle would be the same as that of the discontinued Saint-I: to have the capability of inspecting suspected satellites and, if these are proved dangerous, of annihilating them. But this is still not an approved program. Studies are now underway to determine what a Saint vehicle should finally be like.

Probably it will not only incorporate those inspection and destruction capabilities, but in addition it will be a manned satellite. However, our Department of Defense proceeds cautiously in this matter. There is an expectation among our experts that the Department of Defense will approve no more than the development of the technology for a manned satellite interceptor but not the building of the manned satellite interceptor itself.

Orbiting Bombs?

We as a nation are reluctant to get into that much of an arms race in space weapons. Deputy Secretary Roswell Gilpatrick has made this abundantly clear in several of his recent public speeches and in Congressional testimony. He flatly assured the world, and primarily the Soviet Union, that the United States was deliberately abstaining from developing such offensive weapons as an orbiting bomb, for whatever purpose—antisatellite or what have you—it may be used. The present position of the Defense Department is that no damage can be done to a foe by offensive satellites (or counter-satellites, as it were) that cannot be wrought more surely and cheaply by missiles, bombers, and other nonorbiting weapons.

Yet this too must be remembered:

We will not develop antisatellites or orbiting bombs only if we are reasonably certain that the Soviets will not do this either. James Trainor in the December 24, 1962 issue of *Missiles and Rockets* observes correctly that no such assurance has been made publicly about our anti-ICBM missile development work, "but this does not mean that private guarantees have not been made." Yet private guarantees may mean less than public ones.

Of course, neither side—ours or the Soviet—trusts the other, no matter what guarantees are given, either publicly or privately. This is why Gen. Baryshev in his *Krasnaya Zvezda* examines every shred of evidence proving or tending to prove that we are taking steps to master the science and art of shooting down enemy satellites. This is why our experiment of October 1959 looms so large in Soviet eyes.

It is with mixed feelings that the Soviets may be regarding our 1959

test of trying to blast to pieces our own Explorer Six. They may on the one hand be alarmed, since the test proved that we could quite possibly shoot down one of their Soviet satellites if we came to judge it as a threat to us. But on the other hand they may be pleased—pleased to know that by that test we pretty nearly proved that the Soviets too can shoot our Samos or Midas. As Col. Parson rightly observes about any satellite: "If the target is sufficiently sophisticated to be a threat, it will probably be large enough to be tracked by powerful radar detection systems, at least in lower orbits." And then destroyed!

In fact, a Pentagon official, speaking informally, once suggested this possibility:

We don't publicize our Samos, Midas and other secret satellites beyond the brief initial announcements of their launching. Nor do the Soviets advertise their secret satellites. Suppose, then, that the Soviets finally shoot down one of our satellites but don't disclose this news—and we, too, keep it a secret, following our general policy of secrecy with regard to such satellites' orbiting and work. Suppose we simply retaliate by shooting down one of the Soviets' secret satellites. And they in their turn remain silent about their loss.

Thus a silent, secret war may unfold in outer space, with only a handful of scientists, engineers, and officials on earth, both American and Soviet, being aware of it!

So, to the question, "Can a satellite be shot down?"

The answer is, Yes, it can, but if and when this happens, the intriguing phenomenon may remain mankind's most important secret—a secret kept by a few from the rest of us, and no war on earth may result from it.

ANEMONES MOVE WITH HERMIT CRABS

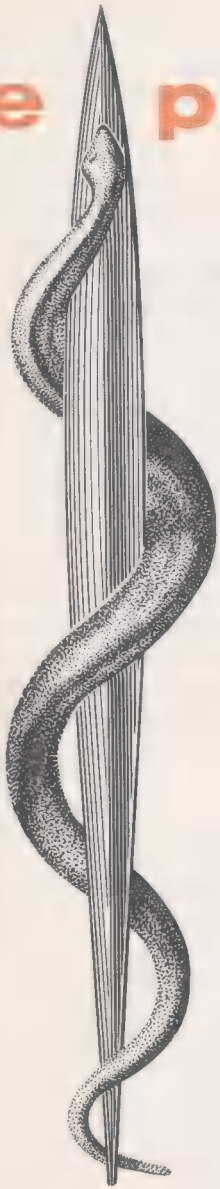
THE ABANDONED SHELL HOME of a hermit crab generally has one or more sea anemones living atop it. The roof dwelling anemones act as camouflage for the shell, helping protect the crab from its enemies.

When a growing crab finds it necessary to move to a larger shell, he sometimes takes his rooftop anemones with him. Two University of Alberta zoologists, Dr. D. M. Ross and Dr. L. Sutton, have filmed a five-stage behavior pattern by which some anemones transfer themselves to crab occupied shells without a crab's assistance.

From experiments with empty snail shells, chemically treated shells, shells never occupied by crabs, and plastic-coated shells, an unidentified "shell factor" emerged. It must evidentally be present on the snail shell before the anemones will transfer to it.

Even when the crab does all the work of moving them, "the anemones' active cooperation is required for the success of the performance," Dr. Ross said.

the progress of



by Arthur J. Snider

SUSCEPTIBILITY TO MIGRAINE THOUGHT TO BE INHERITED

About one out of every ten persons suffers from migraine headache, and usually the headache is hereditary, says Dr. Adrian M. Ostfeld, associate professor of preventive medicine, University of Illinois. If both parents have migraine headaches, there is a 70 percent chance that their child also will have them. If only one parent has migraine, the chance for the child is about 45 percent. If neither parent has migraine, but it is present in the family's medical history the odds drop to 25 percent. Dr. Ostfeld says migraine headaches can be treated effectively with ergotamine tartrate, a drug.

SEIZURES CONTROLLABLE IN HALF OF ADULT EPILEPTICS

Repeated studies have shown that with care and persistence, complete control of seizures can be brought about in approximately 50 percent of adult epileptics. An additional ten to 20 percent may have marked reduction of seizure frequency. Control is likely to be more difficult, says Dr. Richard L. Masland of Bethesda, Md., in those instances where there is extensive brain dam-

MEDICINE

age and intellectual impairment. Dr. Masland, director of the National Institute of Neurological Diseases and Blindness, adds that the increasing effectiveness of anticonvulsant medication over the last 20 years gives hope that further advances can be anticipated.

FIVE REASONS THAT MOTIVATE TEEN-AGE EATING HABITS

Teen-agers love to eat because of (1) a desire to gain weight to make the football team; (2) the need for high food intake during the growing years; (3) an economic status that puts a stop at a drug store or drive-in easily within the budget; (4) overfeeding earlier in life by overly permissive parents; (5) going along with the gang.

It's unrealistic, says Dr. Joseph L. Bordenave of Geneva, Ill., to expect youngsters to be impressed by such older age problems as high blood pressure, diabetes, and hardening of the arteries.

Getting an overweight teen-ager to trim off excess poundage can be difficult, Dr. Bordenave says. It is one thing to counsel the mature person who is motivated by a realization that overweight is a disease. It is quite another to instill motivation in the immature individual who is in a doctor's office chiefly at the insistence of his parents.

"I am particularly dismayed when the overweight youngster is accompanied to the office by his 184-pound mother who professes concern about his weight," the physician adds.

SYNTHETIC HORMONE SEEN AS ANSWER TO FEMALE BALDNESS

A dermatologist who specializes in hair growth believes the answer to baldness in women probably will come within ten years in the form of a synthetic female hormone.

Dr. Norman Orentreich of New York says the quest is under way in many pharmaceutical houses for a hormone that is chemically tailor-made to neutralize the male hormone that is present in all women, especially after menopause.

While the cause of baldness is not known, there is general agreement that the male sex hormone plays an important role. Dr. Orentreich notes that many women are getting the male hormone from doctors for easing painful menstruation, for controlling weight, swelling of breasts, fibroids, and for general toning up.

"Baldness is a chemical problem

and the answer lies in chemistry," says Dr. Orentreich, who is assistant clinical professor of dermatology, New York University. "I believe the answer will come for women in the form of a female hormone that has a specific application."

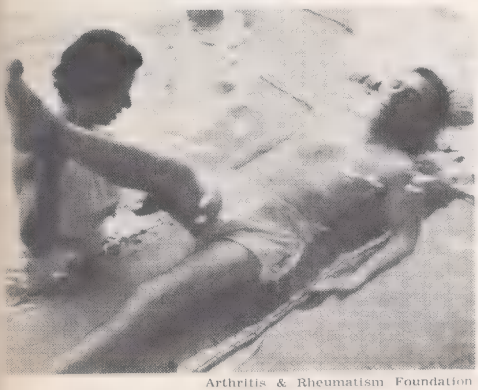
The current feminine fad of wearing a wig is harmless, the specialist said. When properly applied, it will not damage the scalp or promote baldness. Properly applied means it should be attached in several places so that on removal, the stress is distributed.

PHYSICAL THERAPY RESTRESSED IN ARTHRITIS TREATMENT

The theory that arthritis is caused by infection has been largely abandoned. Today's thinking is that the disease is caused by a chemical intoxication, possibly the result of some profound cellular allergy. Dr. Russell L. Cecil, internationally known arthritis specialist and consulting medical director of the Arthritis and Rheumatism Foundation, adds that treatment of the crippling disease is swinging away from drugs and back to a therapy that includes more physical medicine.

A great many drugs have been advocated but few of them have proved valuable. Indeed, says Dr. Cecil, the drugs of real value can be counted on the fingers of one hand. The most popular are the pain killers, chiefly aspirin, gold salts, and the corticosteroids. Aspirin, if taken in large enough doses, goes a long way toward relieving pain and stiffness. When combined with heat or hot baths, it is even more effective. As a drug, aspirin has several valuable features. It is safe, it is cheap, it rarely upsets the stomach, and it never loses its effectiveness, no matter how long it is continued.

"There is a decided trend toward what might be called the physical treatment of arthritis as opposed to drug treatment," Dr. Cecil continues. "By physical treatment I mean rest, exercise, heat in all forms, hydrotherapy, occupational therapy, and rehabilitation in general. Much stress is now being placed on regular calesthenic exercises, so greatly needed to overcome the muscular wasting which accompanies arthritis. Hydrotherapy also includes the use of exercises in warm water, one of the most useful measures the physician has at his disposal."



Arthritis & Rheumatism Foundation

Hydrotherapy is external use of water for specific therapeutic purposes. In treating arthritis it is combined with calesthenic exercises to help prevent muscle atrophy.

Arthritis & Rheumatism Foundation

The hand of an arthritis victim is given a hot paraffin bath to warm it before beginning restorative exercises. The baths can be given at home by a skilled therapist.

Every person, if he lives long enough will eventually develop some form of arthritis. In many cases, the disease produces either mild symptoms or no symptoms at all.

MECHANICAL BRAINS WILL AID DOCTORS

In years to come, predicts Dr. William R. Best of the University of Illinois, computers will exert a profound influence on the practice of medicine. They will not replace the physician, but they will sharpen his diagnostic and therapeutic abilities. Hospital care will be streamlined. The shortage of house officers will be felt much less acutely than at present because many time-consuming tasks of the house staff will be taken over by computers.

Medical research also will benefit from computers. Rapid retrieval and summary of case histories for investigative purposes will be available. What would take days or weeks of statistical analyses can be accomplished in seconds to minutes with a computer.

The possibility of establishing input-output units at nursing stations, laboratories, and other key locations of a hospital, all monitored in a sensibly simultaneous fashion by a central computer facility is being studied, Dr. Best points out in the *Journal of the American Medical Association*. Doctors' orders, records of pulse and blood pressure, nurses' confirmation of administered medications, x-ray reports, laboratory reports and other data would be generated for a given patient from various input stations. Transmission to other concerned units in the hospital would be almost instantaneous. For example, a drug order would be transmitted to the hospital pharmacy and to that portion of the computer memory relating to a patient's hospital charges. In the pharmacy, a label would be generated for the medication bottle. An order for laboratory studies would generate labels for appropriate specimen tubes. Reports would be available at a nursing station as soon as analyses had been completed in the laboratory. The computer would signal the nursing staff when particular medications should be given. The nurse would respond with a simple code to indicate it had been given, eliminating much of the tedious

record-keeping necessary at present.

How about use of the computer for making diagnosis? Present diagnostic models require a background of probability figures which are not generally available, but Dr. Best is certain that one day computer diagnosis will become commonplace.

BRAIN TUMOR FEARS EASED BY STATISTICS

Brain tumor, a diagnosis that still strikes terror in the minds of laymen, holds no fear for surgeons. The misconception that the patient has little chance of surviving an operation is cleared up in some figures released by the University of Chicago.

Dr. Sean Mullan of the division of neurological surgery reports that in 100 patients, between three and 70 years of age, the mortality rate was three percent. This rate puts brain tumor operations in the same safety category as other major operations. It does not mean that 97 percent of brain tumor patients are cured. Progression of the disease is inevitable in many. But of the 97 survivors in Dr. Mullan's series, 49 returned to work. Thirty-four patients turned out to have noncancerous tumors.

The downward mortality trend is attributable to earlier diagnosis by referring physicians, more accurate location of tumors, meticulous attention to technique, better anesthesia, and antibiotics. When Dr. Harvey Cushing pioneered in brain surgery in the early part of this century, the mortality rate was 30 percent. By 1932, Cushing reported an over-all case mortality of 20.4 percent. Cushing went on to predict that "in another 30 years" surgeons could easily obtain a case mortality of four or five percent. Mullan's report not only bears out the prediction but also adds in the *Journal of the American Medical Association:*

"A goal of zero mortality is now no less realistic than was one of four to five percent to Cushing 30 years ago."

For the solution of current problems plaguing brain surgery, Mullan pointed out there is evidence that gamma globulin given after surgery can prevent hepatitis in patients who get blood transfusions. Radioactive scanning of the brain will help diagnosis of cases even earlier. Smaller biopsies examined under the electron microscope will reduce the risk of hemorrhage and swelling.

DRUG DELAYS COURSE OF MUSCULAR DYSTROPHY

For the first time, a treatment has been developed that appears to slow the course of muscular dystrophy, the crippling disease that turns muscle into fat. Dr. Robert M. Dowben of Northwestern University cautions, however, that it is not a cure.

The treatment consists of two pills and exercise. It attacks the disease from a new point of view. Dr. Dowben believes the muscle cells in MD patients lose proteins

and nutrients more rapidly than normal cells. A pill, digitalis, theoretically makes the cell more "leakproof." A second pill, a steroid, supposedly helps the cell build up new protein faster and prevents the replacement by fat. Exercise maintains muscle tone.

Dr. Dowben has treated 37 patients for periods of five to 19 months. Eight appeared to gain some strength, two got out of wheel chairs for a time and three became worse. The rest became no worse—at least temporarily.

In dystrophic mice treated for several years, the life span was extended from an average of four months to one year. But the progression of the disease was inevitable, although at a slower rate.

Muscular dystrophy, a hereditary disorder almost exclusively of males, afflicts an estimated 200,000 Americans, about half of them children. Youngsters start out with normal birth but between the ages of four and six find difficulty in climbing stairs. As the disease progresses, they become too weak to get up when they fall. They are soon reduced to crutches and then to wheel chairs.

Deterioration of the chest muscles makes MD patients susceptible to lung infections and heart disorders. Few live to adolescence.

All of Dr. Dowben's patients have been in the advanced stages of the disease. With the ability in recent years to detect chemically the presence of muscular dystrophy in earlier stages, the treatment may become more effective in newly-diagnosed patients. It remains to be seen how much of the improvement has resulted from a "psychological lift," Dr. Dowben explains.

A limitation to the effectiveness of the treatment is the availability of the steroid. Manufactured in Germany, the supply is "virtually nil." It will not be available to practicing physicians for several months.

'HOT' DUST TESTS LUNGS' RESISTANCE

The "dust test" has been developed as a way of telling how well the human lung can protect itself against infection. For projection against injurious particles that might be inhaled, the lung depends on thousands of hairlike filaments that line the breathing tubes. These act rhythmically to sweep out foreign particles, thus preventing germs from lodging in the lungs and producing injury or infection.

As a means of measuring the effectiveness of this broom action, Dr. Angelo Toigo of the University of Illinois has devised a novel test. The patient is given a small amount of harmless, highly purified graphite dust, such as might be scraped off a lead pencil. This dust is labeled with a small amount of radioactivity. The time taken by the tagged dust to leave the lung can be determined by measuring the disappearance of the radioactivity from the lung. The test has been applied to both normal individuals and those with lung disease.

Sunlight creates an Egyptian god

by Jan K. van der Haagen

Condensed from the Unesco Courier

The Egyptian temple of Abu Simbel constructed by the Pharoah Rameses II is more than a triumph of ancient engineering. The Egyptians were expert astronomers, as well as superb builders, and they combined these skills in building the monument. Jan K. van der

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◀ The main features of the facade of the temple at Abu Simbel are the frieze of baboons at the very top; the falcon-headed sun god, surmounted by sun's disc, set in a niche between the four great statues of Rameses that form the main part of the facade. Between the statues at the bottom of the facade is the entrance to the temple itself.

Haagen, director of Unesco's Nubian Monuments Service, uses modern astronomical knowledge to uncover the mysterious purposes which led to the construction of the temple.

FORGOTTEN for many centuries, engulfed by desert sands, and finally rediscovered in 1813, Abu Simbel is still a storehouse of secrets. What mysterious purpose determined the activities of the engineers who executed the orders of Rameses II?

Why does the temple embody such strange lighting effects. These effects can hardly result from mere chance. With what intent was the interplay of rock and sunlight so expertly combined?

Now, as Unesco is leading a campaign to save many of the temples of Nubia from being swallowed up forever by the artificial lake that will be created by the new Aswan dam, one special aspect of the Great Temple deserves closer study: the relationship between its structure and the rising sun.

The facade of the temple faces east, but not due east. It runs slightly north-east/south-west. Throughout the year it receives the first rays of the sun almost directly as soon as the sun rises from the hills on the opposite bank of the Nile. The sun first lights up the frieze of baboons, over six feet high—there were once 22 of them—topping the temple facade.

The Egyptians had observed that baboons are in the habit of uttering loud cries just before sunrise. In Egyptian mythology, they became the helpers at the birth of the god Re every sunrise after his danger-

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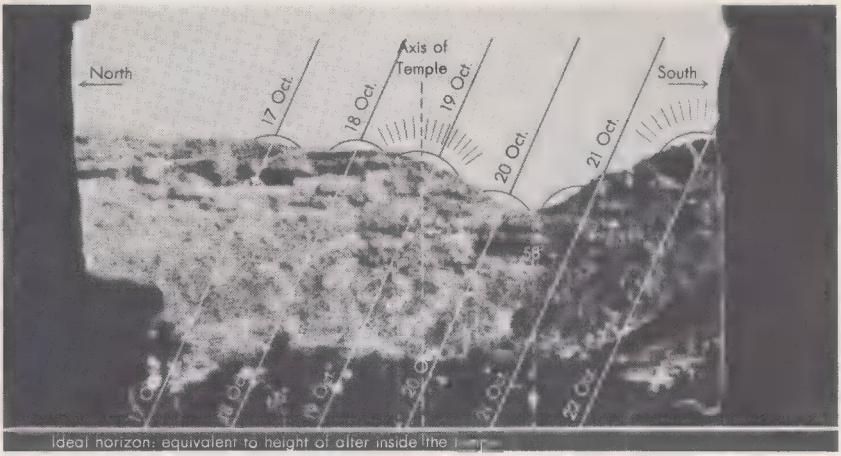

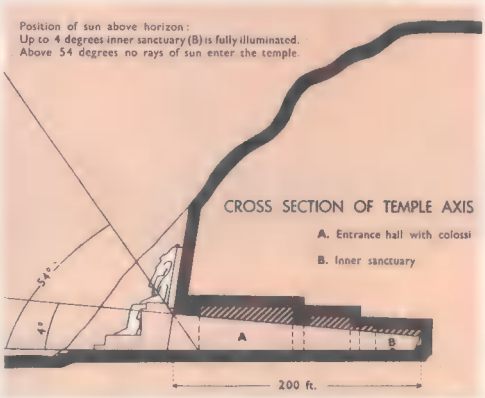
Position of sun above horizon:
Up to 4 degrees inner sanctuary (B) is fully illuminated.
Above 54 degrees no rays of sun enter the temple.
CROSS SECTION OF TEMPLE AXIS
A. Entrance hall with colossi
B. Inner sanctuary
54°
4°
A
B
200 ft.

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Diagram of how the rising sun appears over the hills in front of the temple of Abu Simbel, as seen from the interior of the temple (above). Cross section of the temple (right) shows how the sun's light penetrates the inner sanctuary (B). The rear wall is illuminated for only a few days each year.

ous journey through the darkness of the underworld.

At dawn, the sun god leaves his nocturnal bark for the ship of day and resumes his triumphal journey through an eternally blue sky. The baboons dance with joy to celebrate his victory over the lethargy of night.

A few moments later on the face of the temple, the rising sun is greeted by what seems to be his own image: the god Re Horakhti (the sun rising on the horizon) standing in an oblong niche beneath the cohort of baboons above the high doorway leading into the underground temple. His falcon head is surmounted with the sun disc from which a cobra spits fire. On his left hand and on his right, the pharaoh offers up to the god the

supreme gift of an absolute sovereign: the image of Maat, goddess of balance, of justice, and of truth.

But is the statue really of Re Horakhti? Under his right hand is a dog-headed scepter (in Egyptian "user") and, under his left hand, the traces of a small statue of Maat, which is difficult to recognize today but which appeared clearly in drawings made at the beginning of the 19th century when the temple was rediscovered.

These elements, with the name of the god himself, complete a rebus of the name Rameses chose for himself when he acceded to the throne: User-Maat-Re. Here is an identification of the pharaoh with the god.

Lights Rameses' Statue

A few moments later, still rising, the sun lights up the colossal statue of King Rameses—more than 65 feet high—who has now discarded his divine metamorphosis. While it was customary to place the statue of a sovereign close to the entrance of a temple built at his command, at Abu Simbel the entire facade actually consists of the four statues of the king.

Between the moment when it lights up Re Horakhti and the moment when it shines full upon the statues of Rameses, the rising sun reaches the entrance of the temple. Its first rays faintly illuminate the upper part of the wall at the back of the chamber of statues. This chamber or entrance hall, which corresponds to the "first court" in classic Egyptian open-air temples, is divided into three aisles by a double row of four pillars against each of which stands a statue of the pharaoh.

Although these pillars are generally called "Osirian," they represent Rameses and not Osiris. It is true that the pharaoh holds in his hands the crook and the scourge which are the attributes of Osiris, sovereign of the Empire of the Dead, but these objects had already long been the insignia of royalty.

In conformity with the classic Egyptian plan, the corridors become narrower and narrower, and the successive chambers smaller and smaller, the ground sloping upwards as the roof slopes downwards.

Viewed from any spot on the globe, the sun is seen to rise at the same point only twice a year. Consequently, in the underground temple of Abu Simbel, the play of light deep within the earth varies constantly. When the summer solstice comes round and the sun rises to the north of the axis of the temple, the seat and legs of the statue of Rameses on the facade to the north of the entrance prevent the first rays of the sun from penetrating the temple. A little later in the morning it is the lintel of the doorway that serves as a screen.

Jan K. van der Haagen, former chief of the Museums and Monuments Division of Unesco's Department of Cultural Activities is now director of Unesco's Nubian Monuments Service. He is the author of books on 18th-century landscape painting in the Netherlands and on iconography.

National Geographic Institute, Paris

Statue of Rameses, the king-god, on the rear wall of the sanctuary is illuminated by the first rays of the sun twice each year.

Not until September 10th do the sun's rays reach the face of the first colossus on the left in the big chamber. On following days they reach farther in. A photograph which I took on October 6, 1959, shows that the last colossi on the southern side were the first to receive the light.

The culminating point of the cycle lies between October 10th and 30th. During that period the first rays of the sun reach the last chamber, the holy of holies, situated in the heart of the mountain 200 feet from the threshold. At this time the sun-gods seated against the back wall are illuminated, either separately or in pairs, each totally or partially according to the date.

These gods are Amon, the sun-god of Thebes (the capital of Egypt at the time), Re Horakhti, and, seated between them, a god among gods, Rameses himself. The god Ptah, one of those who preside over funeral ceremonies, is not entitled to the divine light. Except for his left arm, he remains in perpetual darkness.

Illuminated by First Rays

Henri Bonneval, leader of the Geographical Institute of Paris expeditions, has made photogrammetric recordings of all the temples in Egyptian Nubia. Bonneval has established that the sun appears on the horizon exactly in the axis of the temple on October 19, and on that day its first rays largely illuminate Amon and Rameses.

As autumn draws to a close, the

sun's first rays reach the colossi on the north side and finally those seated nearest the entrance. After November 30, the sun is once more banished from the sanctuary. But less than a month after the winter solstice, on January 20, the sun shines inside once again. In January, February and March, the phenomena just described take place in the opposite order. Amon and Rameses are reached by the first rays on February 21.

Has Religious Implication

The sudden illumination of these statues deep underground is breathtaking. Its religious implication seems clear: divine light seeks out from the very bowels of the earth the man who holds divinity within him. Since the temple seems deliberately to have been constructed on an axis not exactly at right angles to the facade—which had to run according to the cleavage plane of the rock—the question arises as to whether the dates of February 21 and October 19 have a particular significance.

The spring equinox (March 21 or 22) and that of autumn (September 22 or 23) immediately jump to mind. Searching for an explanation of the difference of one month, I wondered whether the phenomenon called the precession of the equinoxes might not be involved. In the Platonic year, which lasts nearly 26,000 ordinary years, the celestial poles describe wide circles, finally returning to their point of depar-

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The entrance to the temple between the four statues that form the facade. The sanctuary is 200 feet in back of the entrance.

Documentation Centre on Ancient Egypt

At the northern end of the temple at Abu Simbel is the little chapel of Re Horakhti. Its axis is pointed nearly 30 degrees south instead of at right angles to the terrace. The author believes that the chapel is oriented in such a way that a priest posted in the center would, at the moment of the winter solstice, see the rising sun exactly in its axis. The solstice is identified with the rebirth of the sun god. Thus religion and astronomy were closely intertwined in Egypt.

ture. Thus the entrance of the pyramid of Cheops was orientated, according to the French astronomer Camille Flammarion, towards a star which then played the part of the pole star. Similarly, might not the axis of the temple at Abu Simbel be orientated towards a point which today has no particular significance, but which, when the temple was built, was that of the rising sun at the time of the equinox?

Astronomy soon proved that the precession of the equinoxes played no part here; so I had to look for another explanation. Could the dates of October 19 and February 21 have been of special importance in Egypt in the time of Rameses II?

The French Egyptologist Louis Christophe retraced the history of the construction of the underground temple. After detailed studies of the figures carved on the facade and the bas-reliefs inside, he concluded that the decoration of the oldest parts must have been completed before the 26th year of Rameses II's reign and that of the principal chambers before his 34th. The temple would thus have been built towards the time of the sovereign's jubilee, in the 30th year of his reign, the famous Heb-Sed.

The Heb-Sed was one of the important ceremonies in Egypt at the time of the pharaohs. Probably the survival of a prehistoric custom, the

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On October 6 the sun illuminates the statues of Rameses in the entrance hall of the temple. The photo, taken by the author on October 6, 1959 shows that the last statue on the southern side was the first to receive the light. The rear wall of the inner sanctuary can be seen at the end of the temple's narrowing corridors.

ceremony consisted of putting the head of the tribe to death with great pomp lest he become senile and harmful to the community. On his jubilee, the pharaoh had to prove that he was still in full possession of his faculties—after which he was enthroned as his own successor.

According to Louis Christophe, the first sculptures at Abu Simbel were a tentative move to identify Rameses with the sun-god. The identification grew closer as his reign proceeded, and became complete in the 30th year.

What was the exact date of Rameses' first jubilee? It seems to be unknown. Nevertheless, the jubilee was followed by others at much shorter intervals, and we know that the fifth and sixth jubilees of Rameses, who reigned for nearly 70 years, were celebrated during the first days of the fifth month of the civil year. In 1260 B.C. that day corresponded to our October 22.

From this fact, Louis Christophe concluded that the building of the temple was begun with the Heb-Sed in mind, and that it was on that solemn day that the Pharaoh had been deified.

The Jubilee and Sunrise

It will be noticed that there is a difference of two or three days between the date of the royal jubilee established by Louis Christophe and the date at which the sun rises in the axis of the temple. Perhaps it is possible to reduce this difference to one or two days.

Here is how I think this may be done. It seems probable that the astronomer in Thebes or Memphis —who was asked to determine the exact point where the sun rises on October 22 at Abu Simbel—did not know details of the site. Memphis, for example, is nearly 800 miles from Abu Simbel. The astronomer may in consequence have based his calculations on an "ideal" horizon situated on the same level as the temple. In reality the sun rises at Abu Simbel about five minutes after it crosses the "ideal" horizon.—The reason is that on the right bank of the Nile, about 3,600 yards from the temple, there runs a chain of

hills sufficiently high to delay the sun's appearance.

Since, in the month of October at that place, the orbit of the sun makes an angle of 66 degrees with the horizon, the first segment of the sun's disc appears at a slightly more southern point than that where the sun clears the "ideal" horizon. The problem is further complicated by the fact that the crest of hills is far from level and at one point dips steeply.

Does the "astronomical error" really provide a full explanation? Even taking into account the phenomenon which led to the introduction of the bissextile year (leap year), it is evident that a discrepancy of at least 24 hours exists between the day the sun rises in the axis of the temple and the date of the jubilee. If Louis Christophe's theory is correct and the temple offers proof of the deification of Rameses II on the day of the Heb-Sed, the date on which the first rays fully illuminate the statue of the king is much more important than that on which the sun rises in the axis of the temple.

The rays of sunlight do so a little after October 19, and a photograph taken on October 21, 1961, shows the sunlit statue of the king. Taking into account the difference of one day which we have just mentioned as a possible "astronomical error," this brings us to the day of the jubilee.

At the same time, the fact that the depression in the crest of the hills is not in the axis of the temple, but slightly to the south of it, takes

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Statues of the seated gods on the rear wall of the sanctuary are (left to right) Ptah, associated with the underworld (never lit by the sun), Amon, Rameses and Re Horakhti.

on particular significance. On October 21 and 22, the sun seems to keep its point of rising as long as possible in the neighborhood of the depression as if to give its first rays the longest possible opportunity of lighting up the sun-god.

This explanation, of course, is based on the assumption that the ancient Egyptians had great ability in the fields of theory and practical skills. We know this was already the case one thousand years before Rameses. Moreover, once the main lines of the undertaking had been established by calculation, it was still possible for the builders to correct errors. The size of the statues, for example, enabled them to regulate the play of light precisely—as it happens the statues are not all the same size. For this reason it would perhaps be wiser to believe that around the year 1260 B.C. the Heb-Sed fell, not on October 22, but on the day we now call October 21.

The Appearance of a Star

There remains another hypothesis—the possibility of there being a link between the temple and the fixed stars. The precession of the equinoxes does not change the direction in which the sun rises, but it is equally true that the appearance of the night sky was very different 3,000 years ago from what it is today. One may reasonably wonder whether the axis of the temple was not related to the appearance of a star which was important to the Egyptians.

At my request, Henri Bonneval carried out research on this question and his findings are astonishing: for a number of years around 1260 B.C., an exceptionally brilliant star in the constellation of Orion did in fact rise in the immediate vicinity of the axis of the temple.

Orion was one of the rare constellations in ancient Egypt that modern astronomers have been able to identify with certainty. Everyone is familiar with the three brilliant stars of Orion's belt, known for centuries as the Three Wise Men. The middle star, with which we are concerned, bears the Arabic name of Alnitam.

Today, thanks to the "astronomical ceiling" on the tomb of Senenmut in the necropolis at Thebes, we know that Orion, or rather, the three stars in Orion's belt, were of great significance to the Egyptians. Various texts also make it clear that Orion (Sah for the Egyptians) was identified with Osiris, the god of resurrection. "Osiris has reappeared in Orion" says one of the texts of the pyramids.

It seems that the Egyptian calendar was based on the helical rising of Sah and Sothis (our Sirius). The 200-foot-long tunnel formed by the temple was obviously an invaluable aid in determining the moment when the rising star first appeared in the faint light of dawn. The tunnel formed an ideal screen against the rays of the sun when it rose immediately after the star.

There is yet another unsuspected relationship between Abu Simbel

and the yearly course of the sun. At the northern extremity of the terrace which runs along the temple, a terrace bordered with statues which represent Rameses and Horus the Falcon alternately, there is a curious small edifice without a roof. The eastern facade has something of the form of a pylon. The building is known as the Chapel of Re Horakhti. In the center of the building stands what is generally called an altar. However, this altar is not intended for offerings. A stone staircase leads up to it and the priest in office, surrounded by four stone baboons, one in each corner, could watch a particular point on the horizon from between the crennels. The baboons and the small obelisks standing to the north and to the south of what is conventionally called the altar—now preserved in the Cairo museum—prove that it was indeed a sanctuary consecrated to the sun.

There is something unusual about this building. Its orientation is different from that of the terrace and consequently from that of the great temple. The little temple is orientated further to the south.

What is the reason for this? I wondered whether the axis might not have been orientated in such a way that the priest looked straight at the point where the sun appears in the winter solstice—a point which makes an angle of 116 degrees with the north. Vital information on this point came from the Geographical Institute of Paris. The axis of the small temple makes an angle of about 118 degrees with the north. The difference of two degrees is negligible considering that the axis of the small temple is only a few meters long.

Marks Rebirth of a God

Finally, we may recall that the eastern wall of the little chapel has the form of a pylon. According to the theory advanced by Mrs. C. Desroches-Noblecourt, Chair of Egyptian Antiquities, Ecole du Louvre, Paris, the pylon embodies an ancient Egyptian myth about the creation of the world and does so to celebrate the winter solstice and the rebirth of the young sun-god who succeeds Osiris.

What will remain of the play of light between the sun and the temple when Abu Simbel has been raised over 200 feet—a height about equal to the towers of Notre Dame Cathedral—to save it from the rising waters created by the Aswan dam. The line of the horizon to the east will be a little lower. In consequence the baboons will greet the sun five minutes earlier than they have been doing for centuries. But, as 3,200 years ago, with a difference of barely one or two days, the rays of the sun will light up Rameses and the sun-gods at fixed times, leaving Ptah in eternal darkness.

IT IS ESTIMATED that 50 new minerals are added each year to the current list of 1,200 to 1,500 distinctive minerals.

SITE OF MYCEANEAN CIVILIZATION DISCOVERED IN TURKEY

In spite of new electronic and sonic instruments that can find archaeological relics without back-breaking digging, chance still frequently uncovers an important archaeological find.

It was no accident that University of Pennsylvania archaeologist George Bass was on Yassi, a small island off the coast of western Turkey. Near Yassi is a treacherous reef that some 13 centuries ago sent a Byzantine ship to the bottom of the Aegean Sea. Bass was supervising a team of 17 divers who eventually recovered parts of the ship's hull—including keel, ribs, sideplanking, and stringers—from their watery vault, 120 feet below the ocean surface. Six gold coins from the reign of Emperor Heraclius, 610-641 A.D., lamps, and sounding leads, similar to those in use today, were also retrieved.

Since water and supplies were brought to Yassi from the Turkish mainland, it was also no surprise that Bass occasionally visited the nearest coastal town, Bodrum. But it was totally unexpected that a group of Turkish peasants, who had heard that Bass was an American archaeologist, asked him whether the pottery they were carrying had any value. Bass recognized the pottery as excellent examples of earthenware identified with the Mycenean civilization which flourished in Greece from 1400 B.C. until 1100 B.C. Because of its appearance on the western coast, the pottery pointed to the existence in Turkey of another—up to now undiscovered—Mycenean site besides the one at Miletus, located inland in the center of western Turkey.

The Mycenean pottery had been found by camel drivers who were digging for white clay in a large embankment at Muskebi, on the west coast near Halicarnassus. The embankment apparently lay over what was once a formal cemetery. Six chamber tombs, from which the pottery had been carried off as sou-

venirs, had been uncovered. Permission to make authorized excavations in the area has been requested by Bass from the Turkish Department of Antiquities.

EAST VERSUS WEST, A THINKING MAN'S SOCIETY

The mysterious East remains mysterious to the Western mind because Asian peoples have an inability to understand theoretical situations, says a University of Chicago social scientist. This curious powerlessness of Asian peoples when confronted with abstract thought can be traced to the religious foundations of Eastern culture; the teachings of Buddhism, Hinduism, and Confucianism. Motivated as it was by Christianity, Western society, however, stresses abstract and theoretical thought. This kind of thinking produces minds that can grasp the intricacies of complex and far-reaching planning that characterizes modern economic planning.

This explanation for the failures of Asian peoples in economic and other long-term planning is offered by a Viennese, Dr. Bart F. Hoselitz, who is now professor in the Division of Social Sciences at the University of Chicago. Dr. Hoselitz's particular sociologic interest has been the expansion of the economies of underdeveloped countries and the subsequent social, political, and cultural changes of this expansion.

In elaborating on his explanation, Dr. Hoselitz said, "In spite of official efforts in these Asian countries to impose rational plans, their implementation meets with unequal success. Conflicts arise because each project is judged in its own terms rather than as a fitting part of a whole. And the conflicts which do arise often lead to failures in execution, for the participants in a conflict situation tend to interpret each issue as an indivisible whole . . ."

Although Asian leaders may have an understanding of the Western approach, they are often, Hoselitz said, not thoroughly a part of the Western tradition.

"Anyone," he said, "who has maintained close personal contact with Indian intellectuals, for example, must have observed that many of them lead an almost 'Jekyll-and-Hyde' existence." In certain situations they act in a Western manner, but in other matters, "especially relating to the ordinary performance of daily living and close personal relations, they revert to behavior ultimately inspired by esthetically determined attitudes."

This split, Hoselitz observed, is seen in the education of the children of the Eastern elite. The child learns one set of values at home and another at school where his curriculum is probably derived from Western culture. How these differing disciplines influence each other has not yet been determined.

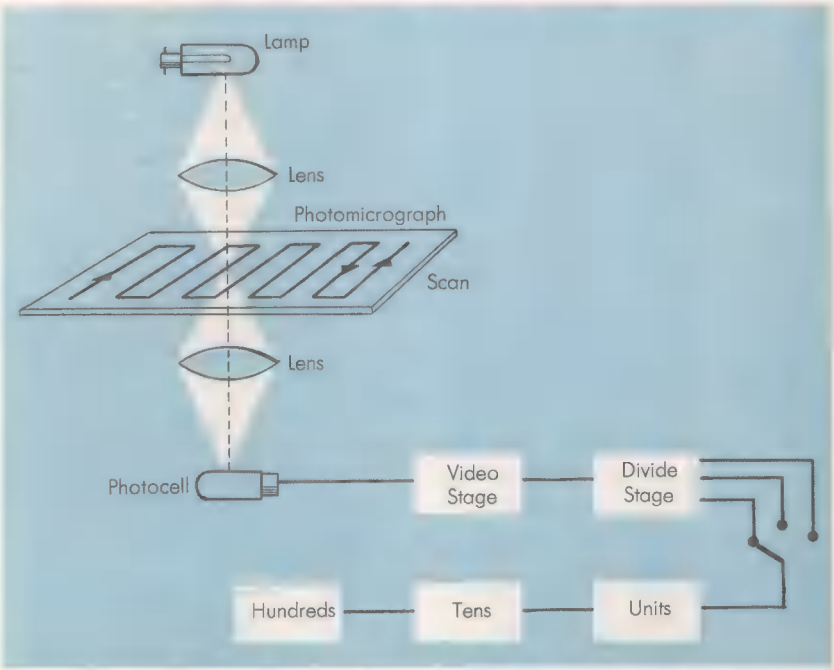
"The basic value orientations of many Asians," Hoselitz said, "conflict with their thought patterns to

a considerable extent. . . . Only when we have looked more intensively and carefully into this interrelation in the changing societies of Asia and Africa will we be able to have a more certain view on the role of values in social and economic change."

MEASURING METAL GRAINS ELECTRONICALLY IN BRITAIN

Metallography is the study—especially by microscopic examination—of the structure of metals. A pure metal is composed of grains and the boundaries between its grains. Measuring the average size of the grains in a particular metal specimen has always been a tedious job, for it means the visual examination of a photomicrograph, an enlarged microscopic view of the sample.

By combining optical and electronic techniques, the National Engineering Research Laboratory of Glasgow, Scotland, has developed an instrument that will automatically measure and record the number of grain boundaries in metal. Called simply the Average Grain Size Counter, the instrument works in the following way: A contrasty



When the boundary of a metal grain stops the optical path of the lamp, an electric impulse is generated by the photocell. The total number of pulses is tallied in units, tens, and hundreds, on an electronic counter, thus automatically counting the grains.

9 by 12 centimeter photomicrograph is prepared at a standard magnification. While being moved in a specified pattern, the photomicrograph is scanned by a beam of light from above. When the optical path of the beam of light is interrupted on crossing a grain boundary in the photomicrograph, a photocell generates an electronic pulse. As the pulses are produced, they are counted; and the total number is displayed on an electronic counter.

The length of the photomicrograph path scanned by the beam of light is 100 centimeters, or approximately 39 inches long. Therefore, when a microscope view is magnified 100 times and is used to produce the photomicrograph under scrutiny, the equivalent length of one centimenter of the metal specimen is being scanned. Adjustments for different microscope magnifications can be made so that the number of pulses is always equivalent to the number of grains in a one centimeter length of specimen.

Improvements have already been suggested for the completely transistorized counter: The mechanical-optical scanner may be replaced with a television scanner so that a count can be made directly from a specimen through a microscope.

AUSTRALIANS SPRINKLE POWDERED BUTTER

Although your breakfast toast will probably be spread with traditionally churned butter for some time to come, a new dairy product called "powdered butter" threatens to replace the familiar golden spread in some cooking applications.

Powdered butter, developed by the Australian Commonwealth Scientific and Industrial Research Organization's Division of Dairy Research, is made by spray-drying an emulsion of butterfat in a solution of sodium caseinate and nonfat milk solids.

The powdered butter that results from spray drying has a moisture content of less than one percent. The fat content of the spray-dried product remains the same as ordinary butter—about 82 percent. Its milk protein content, unlike that of ordinary butter which contains 0.6 percent protein; is 15 percent. It also contains two to three percent added minerals, sodium citrate, sodium aluminum silicate, and calcium phosphate.

Although powdered butter cannot be turned into a spread by simply adding water, it has been claimed as a more valuable food because of its high content of nourishing protein. Although it will not be cheaper than ordinary butter because of the expense of the spray-drying method, its inventors think that powdered butter will lend itself well to dry-mixing with other cooking ingredients—at home and in commercial kitchens—in the making of ice cream, batters, and cake mixes.

Powdered butter, the *New Scientist* reports, withstands tropical climates well. In fact, it does not melt—even in boiling water.

X-RAY DETECTS DIAMONDS IN DYALPUR METEORITE

Fabulous jewels, especially diamonds, are not unknown to India. The Great Mogul, the Koh-i-nor, and the Orloff are only a few that have been found there.

The 787 carat Grand Mogul, found in the Golconda mines about 1650, was reputedly whittled down to 280 carats before it disappeared in the capture of Delhi in 1739. The Orloff, now in the diamond treasury of the U.S.S.R. in Moscow, was originally the eye of an idol in a Brahman temple. The 199.6 carat stone was mounted in the imperial sceptre of the Romanoffs after it was purchased for Catherine the Great by Count Orloff in 1772. The Koh-i-nor, which—starting in 1304—has the longest recorded history of any diamond, finally found its way to the state crown of the Queen of England. The 191 original carats of the Koh-i-nor have been recut to form the 108 carat center stone of the monarch's diadem.

Less impressive in sheer size but of more interest to astrochemists are some diamonds that were recently discovered in a meteorite that fell in India 91 years ago. The meteorite, which fell to earth on May 8, 1872, weighs about ten ounces. Most of it is in the British Museum, London, except for four-tenths of a gram, which is in the Chicago Natural History Museum. It was this museum that permitted Dr. Michael E. Lipshutz, an astrochemist with the National Aeronautics and Space Administration, to remove minute samples, about one-thousandth of a gram, for investigation.

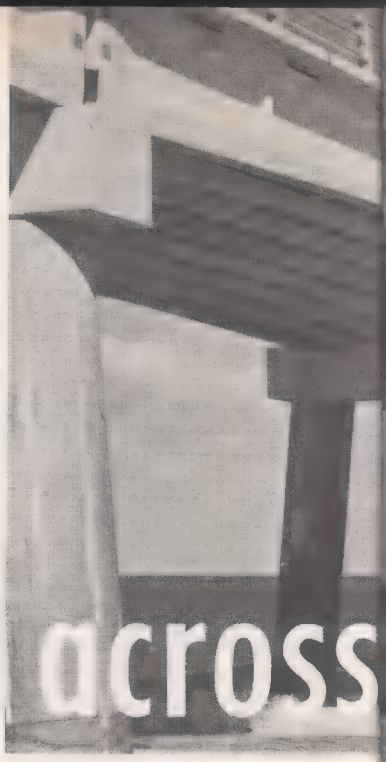
Using an x-ray analysis technique, Dr. Lipshutz observed that the Dylapur meteorite had diamond crystallites in two sizes—a few large crystals and a large number of smaller ones. The larger crystals were barely visible to the naked eye. The diamonds, he concluded, were formed by the shock of the collision between the parent body of the meteorite and another object in space.

While meteoritic diamonds have been known since 1888, x-ray techniques have found them in only three other meteorites. These three diamond-bearing meteorites also revealed their contents under x-ray examination.

Diamonds found in the Great Arizona Meteorite were formed by the shock transformation of its graphite when it struck the earth. The diamonds found in Novo Urei, a Russian meteorite, and Goalpara, another Indian meteorite, were created when meteroids, perhaps a few hundred miles in diameter, collided with each other in space some ten to 20 million years ago. Research into the composition of meteorites is an important part of the investigation of space.

THE VELOCIMETER, a five-inch long instrument, has been developed to measure the speed of sound traveling in liquids.

Early in 1964, trestles, bridges, and one of man's oldest engineering achievements, the tunnel, will give the motorist the pleasure of . . .

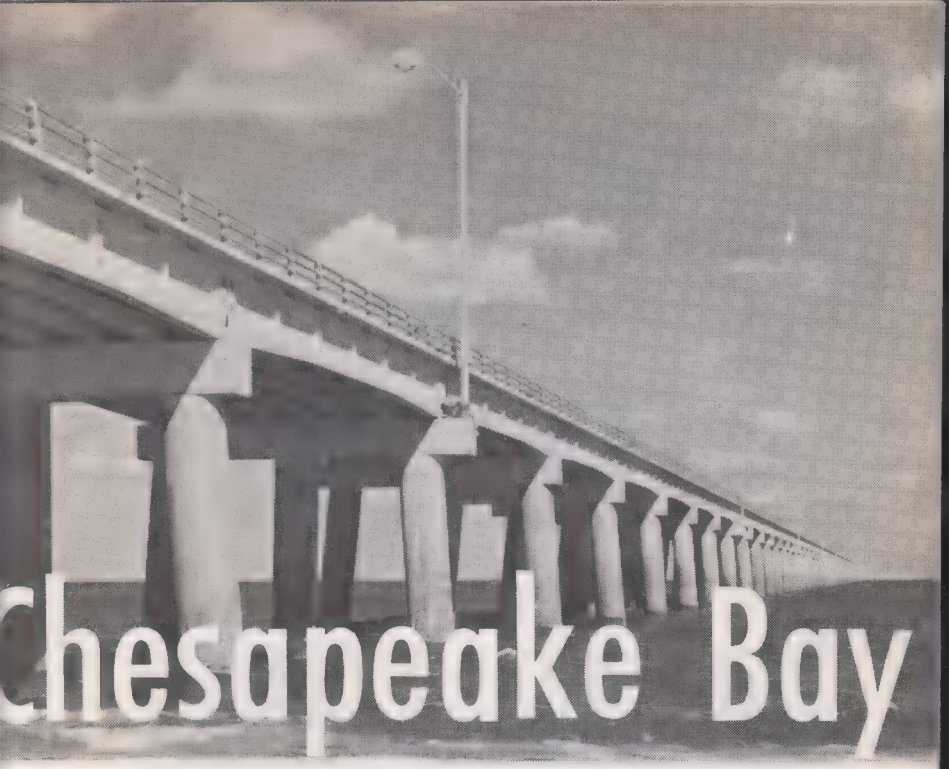


Driving across

MAN has been tunneling the earth for a long time.

Evidence of his prehistoric engineering attempts exist in the surviving subterranean excavations that were used as aqueducts, dwelling places, temples, and tombs. The first tunnel mentioned in recorded history was ordered by a Babylonian king about 2180 B.C. to connect his palace with a temple on the opposite side of the Euphrates. Instead of attempting to burrow through the soft mud of the river bed, the Babylonians diverted the course of the river, then dug across its dry bed a channel in which they erected a masonry tunnel. They then covered the tunnel with earth and returned the Euphrates to its course.

This ancient method of tunnel construction, now known as the cut and cover method, is currently being used to connect Maryland with Virginia—by way of Chesapeake Bay. Two of these trench-type tunnels, two trestle bridges, and two manmade islands are being constructed to span the 18-mile mouth



Chesapeake Bay

Stretching as far as the eye can see, this completed section of the Chesapeake Bay Bridge-Tunnel helps span the 17.5 miles of open water between Virginia and the Eastern Shore of Maryland. The bridge-tunnel will be open for traffic in 1964.

of lower Chesapeake Bay, and eliminate the last natural water barrier to automobile traffic between New York and Florida.

Unlike the Babylonian tunnel, however, these two tunnels—each more than a mile long—are being built on shore and assembled under water. Their inner walls, or cores, are being built in sections—each about 300 feet long—of double-walled steel casing. Built on ways, as ships are, the prefabricated sections are launched at the construction yard at Orange, Texas, and towed 1,700 miles to a special fitting-out pier at Norfolk, Virginia. Here each section is lined with a layer of solid concrete and fitted with a roadway slab. Then pipelines for water supply and drainage are installed as well as communications conduits, electrical power lines, and ventilation ducts.

As a final step, the space between the core, which is a circular shell, 34 feet in diameter, and the octagonal outer wall, which has a span of 37 feet, is filled with tons of concrete—until it is barely able to float.

Tunnel sections were constructed in Orange, Texas, then floated 1,700 miles to Norfolk, Va. where concrete is poured for roadbed and walls.

Four manmade islands will be built in Chesapeake Bay as approaches to the tunnels. Sand dredged from the bay bottom forms the core of each island, which is a quarter-mile long and is eight full acres behind the stone guard.

The section is then towed to the tunnel site and shackled to a specially designed lowering device moored above the exact spot where it will be sunk.

Guided by instruments set up on survey towers, tunnel engineers align the section with a previously submerged length of the tunnel. Once in position, additional tons of concrete—from a floating mix plant—are pumped into the space be-

tween the inner core and outer shell until the section can no longer float. Guided by the lowering device, the section then sinks to the bottom.

If weighed at this point, the watertight tube with its carefully sealed ends would weigh about 12,000 tons, almost as much as a U.S. naval cruiser. However, the tube's buoyancy has been so carefully calculated, that its weight underwater is only 200 tons. This comparatively light and therefore easily maneuvered section is now lowered onto a specially prepared gravel bed at the bottom of the trench.

Linking Tunnel Sections

Divers then lock the new section to the previously submerged sections of the tunnel. For additional ballast, more concrete is used to fill the empty space remaining between the tunnel's inner core and outer shell. The joints where one section meets another are then tightly sealed by rings of solid concrete, and the entire tube is covered with a thick blanket of fine sand.

When the last section of a tunnel is laid, a semicircular earthen dam is built around it. After the area behind the dam is pumped out, the end of the final section is exposed and work on the tunnel begins—"in the dry."

Starting at both ends, the steel bulkheads between sections are progressively cut through, joints are also sealed from the inside, and work is resumed on the interior. The completed roadway will be 24 feet wide between curbs. The overhead clearance above its surface will be 14 feet. Squared-off ceilings and walls will be covered with ceramic tile. A service sidewalk will be provided along one side of each tunnel.

Nineteen individual sections, each using 600 tons of structural steel, will be needed to complete the Thimble Shoal Tunnel.

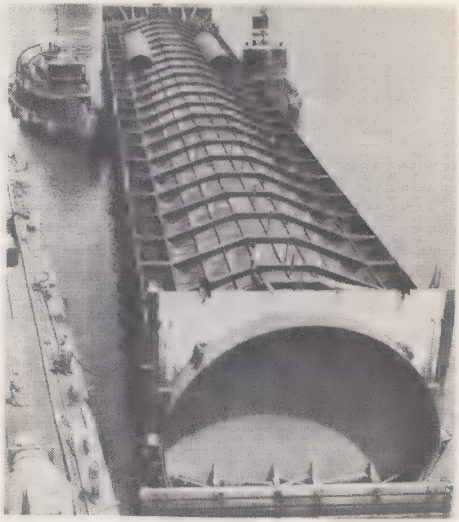
This tunnel, over which will pass ships seeking the deep waters of Hampton Roads, is to be 5,738 feet long. Its counterpart lying beneath the Baltimore Channel, which serves the ports of Baltimore, Annapolis, and Alexandria, will be 288 feet shorter and will need only 18 tunnel sections.

Connecting the tunnels to each other and to the opposite shores will be 12.2 miles of concrete trestle—more than two-thirds the length of the entire 17.6 mile crossing. Like the tunnels, the trestle is being assembled in sections, but at a place somewhat closer than Orange, Texas—Cape Charles, Virginia.

Building a Trestle

There the three major groups of trestle components—deck slabs, pile caps, and cylinder piles—are being cast. Individual cylinder piles are actually made up of 16-foot sections resembling large concrete pipes. These are laid out horizontally and put together. The completed piles are loaded onto barges, hauled to the site, and driven into place three abreast. The pile driver

At the fitting out pier each tunnel section is lined with concrete and fitted with a roadway slab. Conduits, pipelines, and ventilation ducts are also installed at this time.



Tugs nose a prefabricated tunnel section into the fitting out pier at Norfolk. Each section is as long as a football field, with an interior as high and as wide as a three story building. Thirty-seven sections will form the two tunnels.

is mounted on a self-elevating mobile platform whose legs walk along the bay bottom. Similar in design to a Texas Tower radar station, this rig is able to operate above the choppy water of the bay, even in stormy weather.

Maneuverability seems to be the keynote of the oversized machinery that lays the cross pieces and the slabs of roadbed. A specially designed "bridge traveler" levels the tops of the cylinder piles and positions the pile caps, the horizontal beams that bridge and cover the tops of each three-pile group. Then the slab setter, a large movable derrick, easily places 75 tons of roadbed slab, and then moves automatically ahead for the positioning of the next 75 foot-long girder-deck section.

Not all of the surface roadway will rest on concrete trestle. At Fisherman Isle, two steel bridges will be built to provide sufficient vertical clearance for fishing vessels using the North Channel or Fisherman Inlet Channel.

In addition to linking Virginia and Maryland, the Chesapeake Bay Bridge and Tunnel is changing the

natural geography of the bay. Four rectilinear islands have appeared at the entrances and exits of the tunnels. Born of sand dredged from the sea bottom, their eight-acre topographies are edged by a border of large, diverse stones, called a riprap, which protects them from erosion. In addition to being approaches to the tunnels, the islands will sprout accompanying ventilation structures as well as garages.

To delay the traveler the Bridge and Tunnel Commission plans a glass-walled restaurant—with a top deck for dancing—and fishing facilities on one or more of the islands. An estimated average of 5,027 vehicles a day will use the crossing during its first year of operation. The project is expected to open for traffic early in 1964.

AUTOANTIBODIES MAY CAUSE MYASTHENIA GRAVIS

A MISFUNCTIONING of autoimmunity, natural immunization produced within the body, is being investigated as a cause of mysthenia gravis, a chronic, progressive weakening of the muscles of the eyes, face, neck, throat, tongue, and lips.

Although the cause of the disease is unknown, it is believed to result from a functional abnormality in the connection between nerves and muscles. A previous investigation found in the blood of patients suffering from the disease a factor that affected their skeletal muscles. Recently researchers at the University of Buffalo School of Medicine have found evidence that this factor was an autoantibody, originally a protective antibody that has turned against its producer host.

The Buffalo doctors, Ernest Beutner, Ernest Witebsky, Dieter Ricken, and Richard Adler, say there are actually two antibodies concerned. One acts on both skeletal and heart muscles; the other acts only on skeletal muscle.

Evidence of the presence of antibody was drawn from a comparison of ten patients with myasthenia and 32 patients with other muscular and nonmuscular disorders. Among the ten myasthenia patients, tests for antibody against skeletal muscle were strongly positive in two, weakly positive in three, doubtful in eight and negative in two. Among the other 32, they said, no tests were positive, three were doubtful and 29 were negative.

That both types of antibodies were directed against the patient's own tissues, was established by several techniques. In one technique, a blood sample from a patient with myasthenia reacted to a biopsy specimen from her own shoulder muscle in the same way it reacted to other human and monkey muscle specimens.

"The mere demonstration of circulating autoantibodies in spite of exquisite specificity has never been considered by us as sufficient proof of the autoimmune cause of a disease," the researchers said. "Additional evidence might be furnished by reproducing the disease in experimental animals by active immunization. . . ."

Even if it is assumed that myasthenia has an autoimmune cause, the triggering mechanism of the immunologic derangement is unknown.

Crossing species produces strange life forms

A classic example of mixed species, the griffin was reputedly half lion and half eagle.

by Lee Ehrman

IN THE middle of the 16th century, the jumar, an improbable hybrid, was very much alive—in the minds of naturalists, historians, and travelers who reported the existence of this fabulous beast. A bovine equine, or if you prefer, an equine bovine, the jumar was purported to be a cross between a bull and a mare, or a stallion and a cow.

A rare beast indeed, the jumar was not the product of a deliberate experiment in animal husbandry—the science of genetics itself had yet to be born. This hybrid was descended from the menageries of mythical beasts that inhabited the bestiaries of the Middle Ages. In these popular, allegorical books, beasts, birds, reptiles, and fishes were described and depicted—and used to illustrate moral lessons. Drawn from works that were based on the writings of Aristotle, Pliny, and Solinus, the medieval bestiaries dignified the unscientific "facts" that made up the natural history of the period. It was a time when writers and artists rather than biologists crossed different species and came up with incredible hybrids.

Before we fall into the easy trap of criticizing the past from what seems to be the lofty heights of our present-day knowledge, it *might* be profitable to review the theoretical and actual intermingling of species, and the results of such unions. One way this can be accomplished is to trace the successive usages of the word "hybrid" because it designates the offspring of parents that are inherently dissimilar and frequently of two different species. These exotic

offspring, though often easily produced experimentally, are as a rule rather rare in nature.

In order to explain the concept of hybridity, a biologist must know, and must be able to tell others, which animals or plants he has observed or used for his experiments. Now, far from all animals and plants have common names, and frequently the same familiar name is applied to different organisms. This is why biologists had to set up a classification of organisms, a sort of filing system, wherein any organisms would be assigned a definite and unambiguous name.

Cataloguing Animals

The basic catalogue in this filing system is a *species*. An individual organism normally belongs to one and only one species. But there are some exceptions. These exceptions are hybrids—offspring born as a result of a union of parents who belong to different species.

Species is, however, more than a filing card or a category of classification. It is also a biological phenomenon. In modern biology, a species among sexually reproducing organisms is a group, a population, of individuals who interbreed freely, produce fertile progenies, and thus are exchanging genes, their hereditary materials. Different species are groups whose members do not exchange genes, because they are reproductively isolated from each other.

As usual, the rule is not without exceptions. Horses are normally descended from other horses; donkeys are descended from, mate with, and produce other donkeys. Man sometimes causes female donkeys to mate with stallions, and male donkeys with mares. The progeny of these matings are mules or hinnies; mules are hybrids. Or, consider a recent newspaper report about an animal that has been making appearances in increasing numbers in the United States: It is called a "coydog" and it probably represents the result of matings between dogs and coyotes. Domestic bitches in heat have been known to mate with male coyotes, and to subsequently bear vigorous, husky, fertile offspring that are, in addition, fine hunters. We may then say that the coydog is an apparently successful modern hybrid.

The English noun "hybrid" derives from the Latin *"hybrida,"* or, more correctly, *"hibrida,"* meaning the offspring of a tame sow and a wild boar. The Latin, in turn, probably derives from the Greek for hog. But the ultimate source of the word is doubtful. The Latin stem may also be traced, though with less confidence, to the Greek *hybris* which means insult, wantonness, violation, or excessive pride.

It was not until the 19th century that the word "hybrid" came into popular use, denoting an animal or plant of mixed parentage or, less specifically, anything of heterogeneous origin. In his chapter on hybridism, Charles Darwin reserves the term "hybrid" for the offspring of the union of distinct species, us-

ing "mongrel" to signify the offspring resulting from a crossing of varieties. We adhere to the great naturalist's restriction even when we add that "hybrid," according to Webster, may also be used as an adjective, meaning produced by interbreeding or cross-fertilization or, less strictly, derived from incongruous sources.

Herodotus chronicled the part played by hybrids in the Persian Wars, a series of conflicts that raged some 500 years before the birth of Christ:

"After sending these presents to the Delphians, Croesus a third time consulted the oracle, for having once proved its truthfulness, he wished to make constant use of it. The question whereto he now desired an answer was 'Whether his kingdom would be of long duration?' "

The oracle's reply cautioned against a time when a mule would be monarch of Media. This "mule" is later discovered to mean a man whose parents were of different nationalities and of different conditions —his mother a Median princess and his father a lowly Persian. Here the word "mule" is clearly an alternative for "hybrid." Properly speaking, mules are the sterile progeny resulting from the mating of a jackass and a mare, which represent different species. A she-ass mated with a stallion produces an equally sterile "hinny." One might invoke the Greek root, hybris, here since a union such as the one described was then generally considered a violation of a command of "nature" or of gods.

Aristotle's Speculation

A century later, Aristotle speculated on the reason for the sterility of mules and concluded, with the magnificent disregard for observational data characteristic of Greek philosophers of science, that it was because each of the mule's parents belongs to a species that tends toward sterility. Each bears only one young (!), he noted, and mares and she-asses do not always conceive even after mating normally with stallions and jackasses.

"Thus," Aristotle wrote, "when the difficulty of a cross contrary to nature is added (when, too, even in the other case when united with their own species they with difficulty produce a single young one), the result of the cross being still more sterile and contrary to nature, will need nothing further to make it sterile, but will be so of necessity."

We *now know* that hybrid sterility, like other reproductive isolating mechanisms, can occur in degrees. Not infrequently one of the sexes is sterile and the other fertile. Alternatively, the sterility may be incom-

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Lee Ehrman received her B.S. from Queens College in 1956 and her Ph. D. from Columbia University three years later. A lecturer and research fellow in zoology at Columbia University and a research associate at the Rockfeller Institute, Dr. Ehrman has published at least two dozen articles, dealing with population genetics, in leading biological journals.

plete, or may appear in some environments but not in others. More important still, the sterility of different hybrids is produced by different causes. At least four types of hybrid sterility have been recorded:

1. Chromosomal sterility, wherein differences in the *arrangement* of hereditary material (genes) in the chromosomes leads to mechanical difficulties in the cell divisions which produce the germ cells (eggs and sperm) in the hybrid. These cell divisions normally involve the orderly separation and movement of the chromosomes—a process prevented in some hybrids where the parents have contributed chromosomes of different lengths and shapes.

2. Genic sterility, caused by the composition of the hybrid's genes as inherited from its parents, resulting in a *physiological* disturbance in the process of the genesis of mature eggs in the ovaries of females and/or the genesis of mature sperm in the testes of males.

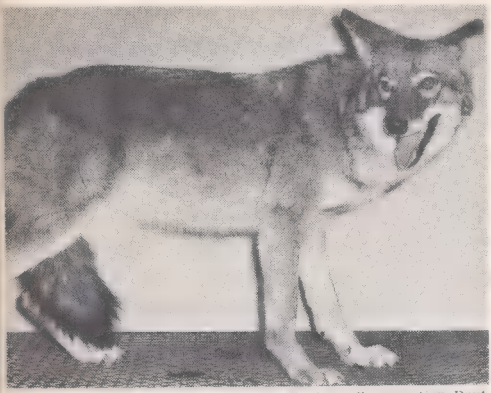
3. Cytoplasmic sterility, which results in failure to produce mature, functional sex cells in individuals developing from eggs deposited by *mothers* of certain genetic constitutions. Here the communication between the cytoplasm and the nucleus, which contains the chromosomes and the genes, is imperfect; this communication is imperative for normal growth and development.

4. Intersexuality, where the hybrids are sterile because they are neither fully formed females nor males.

Our knowledge of medieval ideas of the animal world is derived from the bestiaries and from church art, drawings, and tapestries. Several works on natural history are also extant, notably those of Alexander Neckam, Bartholomew of England, and Thomas of Cantimpré. When examining these representations and texts, it is important to keep in mind the medieval conception of the world as a system of symbols. Nature was not observed for its own sake, but was investigated because it revealed the destiny of man. Each animal held symbolic significance; in reading nature, one read the thoughts of God. People studied manuscripts and not nature itself, and this procedure easily resulted in the compilation of many gross errors.

Birth of a Species

More often than not, animals which appear to us as absurd animal-compounds were accepted on good faith. The griffin, for example, was an animal with a body like that of a lion, and with wings and head like those of an eagle. Its prehistoric, mythological origins appeared in Egyptian religious art, and the griffin itself eventually strayed into natural history. By medieval times, its mixed parentage, if ever so conceived, was not even used to account for its strange configuration; it *was* a species. Many of the hybrid forms that decorate Gothic cathedrals or prowl through the bestiaries are remnants of pagan mythology that were thought by the credulous mo-



N. Y. State Conservation Dept.

Coyotes often mate with German shepherds or collies, producing coydogs, husky modern hybrids weighing up to 50 lbs.

nastics actually to dwell in distant lands.

Travelers' tales, with their propensity for exaggerations and for the fantastic, contributed to the stock of strange beasts that found their way into medieval art and natural history. The fireside story, already responsible for the birth of myth and literature, is also credited with conceiving additional fantastics and grotesques.

Here are some amusing and informative inventions which were very much in evidence before and during the Middle Ages:

Crotate = hybrid between a hyena and a lioness.

Leopard = hybrid between a lion and a "pard." (This stem is more than just a contraction of the word "partner," it may also designate a panther, a tiger, or a giraffe, the camelopard!)

Jumar = the fabled hybrid between a bull and a mare, or a stallion and a cow, or a bull and a she-ass, or a jackass and a cow.

Ostrich = hybrid between a camel and a sparrow.

Giraffe = hybrid between a camel and a leopard.

Two humped camel (Bactrian) = hybrid between a wild boar and a one-humped camel (dromedary).

Manatee = hybrid between an Arab and a fish.

Orange = graft hybrid between a citron and a pomegranate.

Boar = hybrid between a dog and a goat.

Kumquat = graft hybrid between an orange and an olive.

Tyrius = hybrid between a sheep (the ewe) and a he-goat.

Musimo(n) = hybrid between a she-goat and a ram.

Hyena = hybrid between a dog and a cat.

Different breeds of dogs = hybrids between dogs (usually the bitch) and cats (e.g., lions or tigers) or between dogs and wolves (the wolfhound), foxes, and goats.

On Land, in the Sea

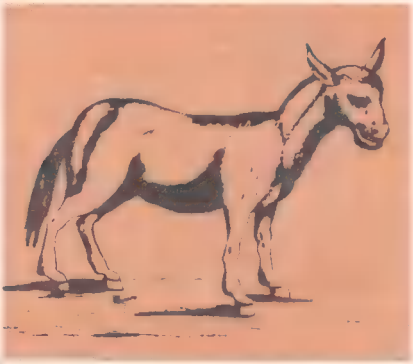
The desire for an orderly and balanced universe led to the belief that everything on the earth had its counterpart in the sea. Hence mermaids, for example, who were the leftover deities of some ancient religion, were made part of the medieval universe without hesitation, and apparently, unlike the manatee, without an accompanying legend of mixed parent-

age. The seahorse, dogfish, and spider crab are other counterparts of land animals dwelling in the opposite element.

By the 17th century, when the crucial concept of actually observing and recording variations *in nature* was being fostered, Francis Bacon insisted that there was much to be learned from studying variations and transitional forms in nature, and that this should be done by observation, experiment, and reasoning inductively Though often technically in error, Bacon's biological insight was impressive for his time (1561-1626)

We are cautioned by Bacon to consider bodies which appear to be composed of two species as singular, or abnormal instances—rare and extraordinary in the scheme of things. He cites:

Moss—between putrescence and a plant;



The jumar, as drawn for a book published in 1669. Its author Jean Leger praised the beast as a saddle animal.

Comets—between stars and ignited meteors;

Flying fishes—between fishes and birds;

Bats—between birds and quadrupeds; and

Man—*Simia quam similis turpissima bestia nobis.* ("How like us is that most disgraceful beast, the ape.")

Such a list must lead us to conclude that, despite a lengthy interval of time, little progress was made in the years between Aristotle and Bacon in clarifying the position of hybrids in the organic world.

'Vital Principal'

Bacon's physician, the anatomist William Harvey, was concerned with Aristotle's concept of the "soul" or "vital principle" as interpreted in the case of hybridity. He agreed that there was an allotment of one vital principle per egg, but wondered "whether is this that of the mother, or that of the father, or a mixture of the two?"

Indirectly, Aristotle had already answered this question while considering the parental circumstances that usually accompany the few instances of interspecific insemination: correspondence in seasons of heat; correspondence in time of gestation; and similarity in body size, so that mechanical difficulties are minimized. If these three conditions were met, Aristotle claimed, then, while the resulting progeny will be exceedingly diverse, they will "at length acquire the form of the female" parent. He

offered as supporting evidence the offspring of fox and dog, and of partridge and common fowl.

Male and Female

Harvey wisely disagreed, deciding upon a mingling of both parental endowments. "In the mule, for instance, the body and the disposition, the temper and voice, of both parents are mingled; and so, also, in the hybrid between the pheasant and the fowl, in that between the wolf and the dog, etc., corresponding traits are conspicuous . . . let us conclude for certain that the female is equally efficient in the work of generation as the male."

With this finally correct statement, we may conclude this brief survey by agreeing with Bacon that we are surely wise to observe closely and to study those hybrids which are actually available to us, for "from their dignity, they must be treated of and classed separately, for they point out admirably the order and constitution of things, and suggest the causes of the number and quality of the more common species in the universe, leading the understanding from that which is, to that which is possible."

U.S. NEEDS AGRICULTURAL SCIENTISTS

ALTHOUGH BURDENED with crop surpluses, the United States is faced with a shortage of trained agricultural people. By 1970, says Clifford D. Siverd of the American Cyanamid Company, Agricultural Division, a 40 percent increase in the number of agricultural scientists will be required.

In all areas of agriculture, the current demand for agricultural graduates is approximately 15,000 annually. However, today colleges and universities are graduating only 7,000 a year.

"In agricultural science alone," Mr. Siverd said, "we will need 20,000 additional people actively at work by 1970." By 1975, an additional 100 million acres of cropland will be needed to feed our people unless agriculture techniques are further improved. It would be difficult, if not impossible, to find this much more land, he said.

"But every examination of the problem turns up a single, dismal fact. Few young people really understand the demands and the opportunities which exist for them in modern agriculture."

The image of agriculture persists in many minds as a matter of tilling the soil and wresting a meager living from the earth. "Apparently we have not successfully communicated the facts to enough talented students. Along with farm and ranch operation, agriculture today needs biologists, engineers, chemists, marketing experts, and even people who can apply high speed computers to the problems of food production. In fact there is hardly an art or a science which is not in demand in the present and the future of agriculture," Mr. Siverd concluded.

BOOKS

Benedict A. Leerburger, Jr.
Book Review Editor

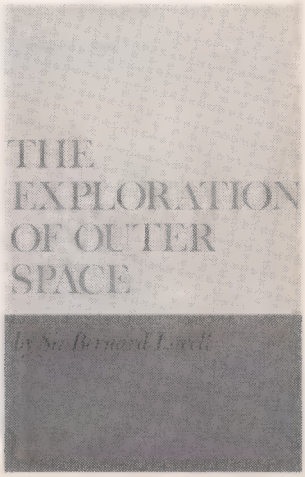
WILLIAM HARVEY, by Rebecca B. Marcus. 127 pp. ($2.95).
JOHANNES KEPLER, by David C. Knight. Franklin Watts, Inc., New York City. 186 pp. ($2.95). These two biographies are the latest in Watts' "Immortals of Science" series designed for the juvenile reader. They are both well written, interesting biographies. Sir William Harvey's discovery of the circulation of blood is told clearly and simply.

Kepler's observations and mathematical computations led to the planetary laws that enabled Sir Isaac Newton to formulate his Law of Universal Gravitation. Mr. Knight does a fine job in explaining many of Kepler's astronomical theories, making this one of the better young people's biographies of the great 17th century scientist.

THE EXPLORATION OF OUTER SPACE, by Sir A. C. Bernard Lovell. Harper & Row, New York City. 87 pp. ($3.00).
THE CHALLENGES OF SPACE, edited by Hugh Odishaw. University of Chicago Press, Chicago, Ill. 379 pp. ($6.95). Sir Bernard, director of the Jodrell Bank (England) Experimental Station, has prepared an excellent survey of today's developments in space. He explains simply the various cosmological theories and how observation with radio telescopes may help clarify many of the conflicts between them. Although there is little talk of space ships, the reader is given a clear background into the many problems space scientists must face.

The Challenges of Space concentrates more heavily on hardware and the problems directly involved with space travel. The book is a summary of our present knowledge as written by some 20 scientists and engineers. Its purpose is twofold: to outline the variety of activities—technical and scientific, domestic and international—that make up man's space endeavor and to stimulate analysis of these activities.

These books present well rounded coverage of space—what it is and how we get there. Lovell's book is

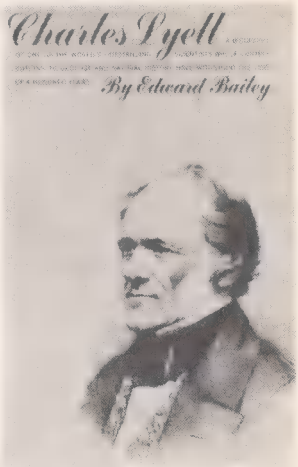


more basic and answers the question: what is outer space? The book edited by Odishaw brings us back to earth to explain some of the mechanics of space travel.

BATS, by Glover Morrill Allen. Dover Publications, Inc., New York City. Paperback. 368 pp. ($2.00). Since the earliest human records, the bat has been one of the most fascinating and mysterious of animals. This paperback edition of the late Dr. Allen's classic work published in 1939 is written so that it can be enjoyed and easily followed by the layman. This bat bible presents a complete survey of the anatomy, physiology, classification, habits, breeding, life cycle, and distribution.

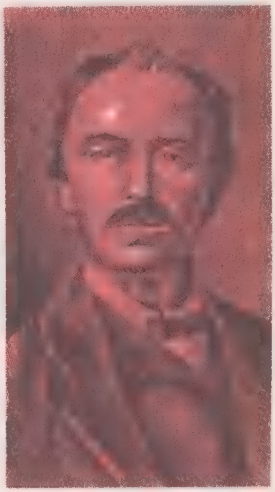
RADIOISOTOPES, by John H. Woodburn. J. B. Lippincott Co., Philadelphia. 128 pp. ($3.50). In clear language, Mr. Woodburn tells how radioisotopes have changed our lives and have opened new avenues of exploration and research for scientists of the future. For younger readers.

CHARLES LYELL, by Edward Bailey. Doubleday & Co., New York City. 214 pp. ($3.95). Among the scientists of the 19th century, Sir Charles Lyell would stand high on any list. His interest and influence was not restricted to his chief discipline, geology, but spread to many other branches of science. Sir Edward Bailey, one of Britain's leading geologists, has done a fine job of capturing the spirit of Lyell's work. Unfortunately, his biography reads like an entry in a scientific journal rather than the close personal narrative it was intended to be. Lyell, as a scientist, comes through beautifully. As a person, however, the great geologist appears like a cardboard figure.



Footnotes: Two rather interesting paperback booklets have been prepared by Acoustic Research, Inc., Cambridge, Mass. *Reproduction of Sound* by Edgar Villchur ($2.00) and *High Fidelity Systems* by Roy F. Allison ($1.00) are both well written, abundantly illustrated brochures covering the physics of recording and the problems of assembling your own home audio system. Although published by a major manufacturer of audio equipment, there is no advertising, and the authors remain as objective as possible. One problem—books are available only from the publisher.

A Science Milestone



Heinrich Schliemann

Archaeologist Extraordinary

by Daniel Cohen

ONE is tempted to believe Heinrich Schliemann never really existed. He is like a character in a moral fable written to inspire school children to work hard, study hard, and never to give up their youthful ideals.

Perhaps only Schliemann could properly describe Schliemann. In 1870 he wrote to his son who was at school:

"You ought to try to follow the example of your father who in whatever situation always proved what a man can accomplish by unflagging energy alone. During the four years in Amsterdam from 1842 to 1846, I truly performed wonders. My achievements there have never been equaled and never will be equaled in the future. Later, when I became a wholesale merchant in St. Petersburg, I was the most brilliant and at the same time the most astute dealer on the stock exchange. When I began to travel, I was a traveler par excellence. No St. Petersburg merchant has ever written a learned

book, but I have written one that was translated into four languages, and generally commended. At the moment as an archaeologist, I am the sensation of Europe and America because I have discovered ancient Troy, that Troy for which the archaeologists of the entire world have searched in vain during the past 2000 years. . . ."

Schliemann was not unaware of the uniqueness of his life. If he had written the letter a few years later he could have added more achievements to the already impressive list.

Schliemann dates the beginning of his archaeological interests to 1829 when, at the age of seven, he received the popular book, the *Universial History for Children,* as a Christmas present. In it he found a picture of the ancient Scaean Gate of Troy. He discussed the picture with his father, a poor pastor in Neu-Bukow, Mecklenburg, Germany. They decided that some trace of such a mighty monument must still exist, although it was unknown to scientists of the day. "And by and by," he wrote in his autobiography, "we agreed that someday I should excavate Troy."

The same sort of story is told about almost every great man; however, in view of Schliemann's character the story might actually be true. But the dream of digging for Troy had to wait a while.

The first 44 years of Schliemann's life would be familiar to Horatio Alger readers. In 1836, at 14, he was working 18 hours a day in a grocery store in the German town of Fürstenberg. In 1842 he was in Amsterdam, destitute until he finally got a job in a merchant's office. Two years later he joined the firm of B. H. Schroder & Co. as a correspondent and bookkeeper.

When he was not working Schliemann studied languages employing a curious but effective method all his own. Within a year he had mastered English, French, Dutch, Spanish, Portuguese, and Italian. In 1844, he mastered Russian, the most difficult of European languages, in six weeks. His knowledge of Russian got him the post of St. Petersburg agent for Schroder in 1846. A year later he had founded his own export-import business in Russia.

Because of his remarkable abilities and equally remarkable luck, Schliemann's business prospered. By the time he made his first visit to America in 1851, he was important enough to be received by the President of the United States. He opened a bank in California during the gold rush and was in the state when it was admitted to the Union, thus automatically gaining American citizenship.

His linguistic conquests also continued. By the age of 33, he had learned 15 languages. In addition to the seven he already knew, he added Polish, Swedish, Norwegian, Slovenian, Danish, Latin, and modern and ancient Greek. Seven years later, while on a tour of the Middle East, Schliemann also learned Arabic—and is reported to have visited Mecca disguised as an Arab.

During this period Schliemann

European civilization was born in the Aegean Sea area. Athens and Sparta were the leading centers of classical Greek civilization. Mycenae and Troy, the sites of Schliemann's great discoveries, were powerful in Homeric times and Crete was pre-Homeric.

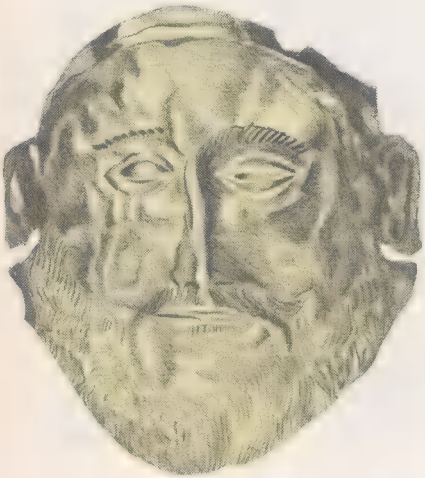
married Katherine, niece of a business acquaintance. But such a commonplace marriage was to bring no joy to Schliemann. The marriage lasted 15 years and produced three children, but it was a dismal failure.

Schliemann became a millionaire. As he stated, "My enterprises had been wonderfully blessed by heaven to such a degree that by the end of the year 1863 I was already in possession of means far beyond my most ambitious expectations."

Business began to occupy less and less of his time. He traveled widely "to see more of the world." He habitually kept journals of his travels in the language of the country through which he was passing.

By 1868 he had decided to retire from business and end his unhappy marriage as well. When he resolved

to marry again, he had his own peculiar system for finding a wife. He contacted an old friend, a priest named Vimpos who had taught him Greek in St. Petersburg and was now Archbishop of Athens. The 46-year-old German millionaire, asked the Archbishop to find him a Greek wife.



Schliemann thought this gold mask found in one of the shaft graves at Mycenae represented the face of Agamemnon. In reality it comes from an era 400 years earlier.

Schliemann wrote his father, "The Archbishop of Greece . . . has sent me the portraits of several Athenian women for me to choose from. Of these, I have selected Sophia Engastromenos as the most charming . . . It seems . . . that the Archbishop, before he was advanced to the higher clergy and while he still thought he would be able to remain a sinner, had intended to marry her. In any case I plan . . . to go to Athens in July in order to marry her . . . For since the growth of my passion for the Greek language, I believe I can be happy only with a Greek woman. I will take her however, only if she has an interest in sciences . . . A pretty young girl can love an old man in such a case only if she cares deeply for the sciences in which he is so far ahead of her."

Despite its odd beginning his marriage to the 18-year-old Sophia was an extremely happy one. She bore him two children, Andromache and Agamemnon. (Schliemann himself chose the names.) Sophia was not only a devoted wife, but an excellent assistant for his archaeological projects as well.

When the seven-year-old Heinrich Schliemann gazed at a picture of the Scaean Gate of Troy, he was looking at a drawing based on descriptions contained in Homer's epic poem the *Iliad,* the story of the siege of Troy. Aside from the poem, the scholars of Schliemann's time had no direct evidence of the Trojan war, or in fact whether Troy itself had ever really existed. Homer was supposed to have written the epic hundreds of years after the war, and it was so filled with the acts of the gods and supernatural feats of heroes that many scholars were inclined to reject entirely its importance as a guide to the early history of European civilization.

Today we know better, and even in 1963 archaeologists are digging up remains of cities that were de-

scribed by Homer but had been otherwise lost to history. Yet in 1846, the historian George Grote wrote of the Homeric times "The times which I thus set apart from the region of history are discernible only through a different atmosphere —that of epic poetry and legend. To confound together these disparate matters is, in my judgment, essentially unphilosophical . . ."

The Greeks who lived after Homer treated the poems as history and so did Schliemann. He approached his archaeological excavations using Homer as his bible. Of the scholars who believed Troy existed at all, the majority held that its site was to be found near the village of Bounarbashi, on the hill of Bali Dagh. But an examination of this site convinced Schliemann that it was not the location of Homer's Troy. *Iliad* in hand, he tried to find a route by which the hero Achilles could have chased Hector three times around the walls of Troy as Homer described. In doing so he encountered a drop so steep that he had to crawl down it on his hands and knees. Surely Homer would not have overlooked so important a detail.

"In addition to this," he wrote, "the distance of Bounarbashi from the Hellespont is, in straight line, eight miles, while all the indications of the *Iliad* seem to prove that the distance between Ilium (Troy) and the Hellespont was very short, hardly exceeding three miles."

There was another possible site, the hill of Hissarlik, which was much nearer the sea. Its claim as the site of Troy was supported by only a few modern scholars, but in Hellenic, and later Roman, times the town of Novum Ilium (new Troy) had stood near it. The Greeks and Romans had believed this was the site of Troy, and Alexander the Great himself had offered at its temple before marching on to conquer the East. Other investigators had done some digging on the hill, but Schliemann resolved to attack it with all his formidable energy.

Nine Cities of Troy

The expedition was ultimately crowned with great success, but it was no easy task. Living conditions were primitive, and during the stifling heat of one summer Schliemann came down with malaria. Winters were worse. Schliemann wrote, the wind "blew with such violence through the chinks in our house walls . . . that we were not even able to light our lamps in the evening, and although we had fire on the hearth, yet the thermometer showed nine degrees of frost." In three seasons of digging Schliemann's workmen moved 325,000 cubic yards of earth and discovered not one but nine cities built atop one another in layer cake fashion.

Which of the many cities that had been built at this site was Homeric Troy? In the second and third levels from the bottom he found traces of fire (Troy was burned at the end of the war), the remains of massive

walls, and the ruins of a gigantic gate. To Schliemann these could be nothing else but the walls that had once enclosed the palace of Priam, king of Troy, and the ruins of the Scaean Gate.

This was enough of a triumph, but there was more to come. On June 14, 1873, just one day before he was to terminate finally his excavations at Troy, Schliemann was supervising the digging in the area he had identified with Priam's palace. Suddenly his trained excavator's eye—or perhaps it was the eye of the merchant—discerned the glint of gold. Quickly he sent the workmen home, and he and Sophia dug with knives and their bare hands. They dug in an area overhung with massive blocks of stone and rubble, which could cave in at any moment, but they paid no attention to the dangers.

The treasure uncovered there consisted of, among other things, two magnificent gold diadems, six gold bracelets, a gold goblet, 60 gold earrings, 8,700 small gold rings, gold buttons, vases of silver and copper and weapons of bronze. This could be nothing other than the fabled Treasure of Priam, to the romantic merchant.

It is almost anticlimactic to point out that the treasure had actually belonged to a king who had lived a thousand years before Priam, and in fact Homeric Troy was not in the second or third layer from the bottom as Schliemann had thought, but rather in the sixth layer. These finds revealed not only Homeric Troy, but Troy that not even Homer had known about.

Schliemann was determined to get his treasure out of the country. Troy was in Turkey, and that country had a loosely framed law regarding antiquities. Schliemann was not going to allow his treasure to be subject to the caprice of local officials. So with the aid of his wife's numerous relatives he had the objects smuggled out of the country. This stratagem was successful, although he was roundly denounced for it, and it caused him trouble when he applied for permission to dig elsewhere.

One of the bloodiest stories in the semilegendary history of Greece is the story of Mycenae—especially of the return of its king, Agamemnon, from the Trojan wars. In the ten years that he had been at Troy, the legend goes, his wife Clytemnestra had taken a lover, Aegisthos, and upon Agamemnon's return they murdered him. It was not only murder that was connected with Mycenae, however, for in the ancient histories the most frequent word used to describe that kingdom was "golden."

So, in August, 1876, Heinrich Schliemann set up camp in the valley which slopes down to the plain of Argos near Mycenae. Actually the site of Mycenae was well known, and several other archaeologists had already dug there. But Schliemann, through a combination of adherence to the ancient writings, archaeological shrewdness, and unusual luck made the first really important finds.

Perhaps it was only because he had decided to dig in such apparently barren ground that the Greek government gave him permission to dig at all, since they were quite suspicious of "the crazy foreigner," after "Priam's treasure" had been smuggled out of Turkey. Even then the government and the Greek Archaeological Society placed many restraints on him. These Schliemann characteristically ignored.

Schliemann uncovered five shaft graves with 15 gold-covered skeletons in them. Never a man to hesitate, he cabled the King of Greece:

"It is with extraordinary pleasure that I announce to Your Majesty my discovery of the graves which according to tradition are those of Agamemnon, Cassandra, Eurymedon, and their comrades, all killed during the banquet by Clytemnestra and her lover, Aegisthos."

Face of Agamemnon

The graves were filled with splendid relics of enormous value. "All the museums of the world taken together," he said, "do not have one-fifth as much."

In the one of the graves he found the well-preserved body of a man, whose face was covered by a golden mask of unusually excellent workmanship. Schliemann cabled the King of Greece.

"I have gazed on the face of Agamemnon."

Again Schliemann was wrong in his enthusiastic interpretation. The royal graves he had uncovered at Mycenae were not the graves of Agamemnon and his followers, but of a people who lived some four hundred years earlier. Coupled with discoveries he made later at Tiryns, the finds at Mycenae opened up an entirely unsuspected era of history. The similarity of pottery of Mycenae, Tiryns and pottery found by other archaeologists at Asine, Nauplia, Eleusis, and the islands, notably Crete, showed that an unknown high civilization had existed which covered the entire eastern coast of Greece, and all of the islands. We now call this culture Minoan-Mycenaen. It was the first true high European civilization, and Schliemann's discoveries had pointed the way.

It is quite ironic that pottery, perhaps the most common and unimpressive object turned up by the archaeologist, rather than all the glorious golden ornaments with which Schliemann was so delighted, ultimately had the most scientific importance.

In the fourth grave Schliemann found what he described as: "A cow's head of silver, with two long golden horns . . . There were also two cow heads of very thin gold plate . . . which have a double ax between the horns."

The "cow" heads were subsequently recognized as bulls heads, and both the bull and the double ax are familiar symbols of Minoan-Mycenaen culture.

Schliemann had actually planned to dig at Crete, specifically at Knossos, the very center of Minoan-My-

cenaen civilization. But the man who owned the hill on which Schliemann had proposed to dig, asked an outrageous price and the merchant revolted and called the whole deal off. For once in his life Schliemann had missed a magnificent opportunity.

Schliemann made further excavations at Troy and also at Orchomenos, the third city characterized as "golden" by Homer. As his archaeological excavations progressed Schliemann grew in scientific stature. He brought to his work care and method that had been lacking in some of his earliest excavations.

The archaeological writer C. W. Ceram in his book *The March of Archaeology*, says, "It is high time the nonsense about Schliemann's 'dilettantism' were corrected. It is true that he made many mistakes—but what pioneer does not make them? The errors perpetrated by professional scientists, especially in regard to pre-Homeric Greece, fill far more volumes than Heinrich Schliemann wrote . . . The charge that Schliemann was no professional stems from that academic conceit which rates proper degrees, even if secured by the most mediocre minds, above genius."

On Christmas day of 1890 Schliemann, who had been suffering from an ear ailment, collapsed in the Piazza della Santa Carita in Naples. He lost his power of speech although he remained conscious. No one recognized the modestly dressed man, and he was turned away from a hospital. When he finally was identified, it was too late. He died that night.

When his body was brought to Athens, the King of Greece and all the important Greek and foreign officials stationed in the city came to pay their respects. Fittingly, by the great man's coffin stood a bust of Homer.

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3-63

Who brought the stork?

by Ella K. Carruth

In mid-November of last year a very odd-looking bird was seen in the vicinity of Estham, Mass. The strange bird interested the director of a nearby wildlife sanctuary, and he traced it to its roosting place and netted it. Found to be cold, exhausted, and half-starved, the bird was taken to the cellar of the sanctuary headquarters, forced fed a light meal of scallops and allowed to rest.

At first the bird was thought to be a black stork; but later when it had regained enough strength to lift its wings, it revealed itself as a white-bellied stork. The general appearance of the two birds is similar. At

rest, with wings folded, the backs of both are glossy black. The white-bellied stork is smaller and does have distinguishing colors about the head and legs. However, the distinctions between the two types of birds are not too well known to bird watchers in this country, for not a single wild specimen of either one had ever been recorded in the United States before.

Both black and white-bellied storks are natives of southern Europe and parts of Asia. During the colder months they migrate to Africa. Even in their native habitats they are not particularly common.

No wonder this poor bird was cold and tired! How did the stork make the long journey across the ocean? Did he come flapping his own wings? Was he aided by strong winds that blew him off course from his original destination? Such things have been known to happen. Perhaps he hitched an occasional ride on a passing ship. Of course, we shall never know.

Orlando Sentinel

C. Russell Mason, executive director of the Florida Audubon society, holds the stork shortly after its arrival in Orlando by jet.

In Danger of Freezing

Whatever happened, there he was in Massachusetts at the beginning of winter. The director of the wildlife sanctuary was sure that the bird would soon freeze to death in the cold climate. The climate of Florida, it was decided, was similar to that of the place from which the stork had presumably come.

A call was made to C. Russell Mason, Director of the Florida Audubon Society. When Mason heard what sort of a bird Massachusetts proposed to send him, he could hardly believe it and, of course, he was eager to see the stork.

A trip by car or train would have been too dangerous for the bird in its exhausted condition, so it was placed in a sturdy, well-ventilated wooden box and put into the cabin of a jet bound for Orlando.

After a quiet five hour trip, the unusual passenger arrived on Nov. 30 at 7:30 P.M. This was undoubtedly the best flying time the stork had ever experienced.

Taped to the outside of the box was this note:

"Please do not feed this bird until

Winter Park Star

Mrs. Margaret H. Hundley and Mason spread one of the stork's wings to display its white belly, the characteristic that gives this species its name. With its wings folded, the bird looks like the all-black black stork, a more well-known European bird.

it reaches Florida. At that time it must be forced-fed a diet of fish, liver, and shrimp.

A facetious footnote read:

"In view of the exhausted condition of the bird we can only presume that not only had the baby been delivered, but that some European family is, by now, greatly mystified."

The European stray was given deluxe treatment in Florida. It was taken to the Audubon Headquarters in Maitland, a town north of Orlando. There it was put in a big, airy cage on a front porch. Fish, liver, and shrimp were periodically forced fed to him by Audubon workers who took turns storksitting. After a few days of this forced feeding, the stork began to pick up its own food from the cage floor if no spectators were present.

Visitors, however, disturbed the shy bird. When alone, he stood on one leg, a characteristic stork pose. But if some one came too near the cage he let down the other leg and took a firm stance. If too many callers dropped in, he turned his back and lay down in a corner.

Early in January, the stork was sent by commercial plane to the Crandon Park Zoo, Key Biscayne, Fla. Here it is hoped he will live more comfortably.

INVENTIONS PATENTS PROCESSES

Burning Building Reaches 1400 Degrees in Two Minutes

How hot does a blazing building get?

Up to 1400° F. two minutes after a fire starts, say Minneapolis-Honeywell engineers who recently took the temperature of a burning building electronically. Working with Minneapolis, Minn., city fire fighters, engineers "bugged" a four-story building in downtown Minneapolis with smoke-and-fire detectors, and then set fire to it. The building was to be torn down as part of an urban redevelopment program.

Smoke Sentries, thermocouples, rate-of-rise and fixed-temperature detection units were mounted throughout the structure and linked to recorders and alarm panels outside.

The fastest report came from the Smoke Sentry, which turned in an alarm in less than three seconds after firemen put the torch to a gasoline-soaked woodpile on the first floor. Within one minute, thermocouples recorded room temperatures of over 1000° as the gasoline literally exploded into flame. As the gasoline burned off, room temperatures rose more slowly, reaching 1400° in about two minutes.

Thermocouples on the other floors recorded smaller rises in temperature. Second floor temperatures peaked at around 300° in three minutes. The highest temperatures on third and fourth floors were about 120° after the same time.

Firemen began fighting flames with foam about seven minutes after the fire was set. Within a minute, temperatures on the first floor dropped to around 100°. Heat on the upper floors dwindled more slowly, since all windows and doors were closed.

Temperatures were automatically logged on a 15-point Honeywell recorder, giving a complete time-temperature report of the fire. Alarms from smoke and fire detectors lit up a fire annunciator panel to show the progress of the heat and smoke from room to room.

Dual-Action Signal For Ships in Trouble

An electronic marine distress signal that acts as a powerful automatic transmitter, as well as a flashing light beacon is being offered by

RAL Industries, Inc., 141 Linden Ave., Westbury, L. I., N. Y.

According to the manufacturers, the signal, called TransRALite, is usable both on commercial and pleasure boats, life rafts and other small craft to bring help quickly in case of trouble.

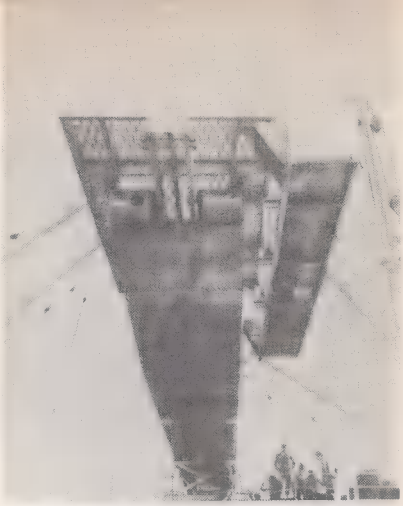
When activated, the hermetically-sealed buoy beacon automatically and instantly transmits its radio signal to monitoring stations on the international distress frequency of 2182 kc. At the same time, a flashing neon light alerts ships up to 15 miles away and aircraft up to 50 miles away. Both signals work continuously for 15 days or more under even the most adverse marine conditions, the firm says.

'Ships Wings' Developed For Seaborne Cargo Loading

Even ships have wings, but they are not for flying.

The U. S. Army Transportation Research Command has successfully tested a technique for quickly unloading cargo from moving ships using helicopters and portable platforms, called "ships wings," which extend over the side of ocean cargo vessels.

Elements of the system include a 66-foot-long aluminum "wing" (foldable to 40 feet for storage on the deck), a movable cargo platform or dolly capable of holding pallet loads of 9,000 pounds, and a base unit mounted on the deck which permits the rotation of the wing. An electrohydraulic winch



U.S. Army

"Ships wings" are designed to cantilever out over the side of a ship. The "wings" are used for loading and unloading the ship by helicopter while still at sea.

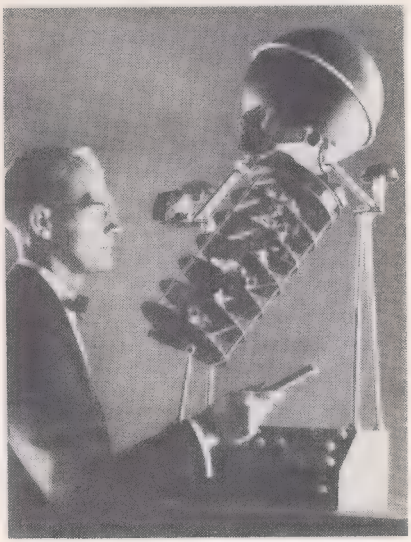
provides the power to move loads from the outboard end of the wing to the cargo hold in 30 seconds.

Although initially designed to load and unload helicopter sling loads, helicopters can also make a direct landing on the wing.

Moderate Priced School Planetarium

A school planetarium, with automatic planetary motion; a sunrise-sunset projector plus a 14-foot sectional dome and mounting is being offered to schools and colleges for less than $4,000. According to the manufacturers, Space Education Laboratories, a division of Harmonic Reed Corp., Rosemont, Penna., the nearest priced comparable instrument with dome is over $20,000.

The relative yearly motion of the planets against the background of



Albert A. Faulkner demonstrates the Nova III school planetarium he developed. This moderate-priced planetarium is designed for use in schools and small colleges.

the stars can be independently shown, and a full year's movement can be demonstrated in four minutes.

In addition to sunrise and sunset aspects, cloud effects, landscapes, and horizons can also be projected. Latitude adjustment is another feature of the planetarium, along with precession, meridian projector, equator projector and ecliptic projector. Separate controls are provided on all accessory projectors. The planetarium is called Nova III.

From 35 to 40 students can be accommodated with the plastic dome.

Space Education Laboratories also will provide complete instruction to cover all phases of operation and instruction.

Strong Safety Glass For Schools, Homes

Pittsburgh Plate Glass Co. has announced the production of a high strength, tempered safety glass designed for use in schools and homes.

Herculite K safety glass is reported to be several times stronger under impact than ordinary glass of the same thickness. Another feature of Herculite K is that should it break under an especially heavy impact, it crumbles into small sized particles rather than large sharp pieces. Not only more difficult to break, it is also far less likely to result in serious injury, the firm points out. Pittsburgh Plate is located at 632 Fort Duquesne Blvd., Pittsburgh 22, Penna.

Common Hydrocarbons Used In New Fuel Cell

A device that represents a step toward the goal of developing a practical fuel cell that will operate on inexpensive fuels such as natural gas has been demonstrated by scientists at the General Electric Research Laboratory, located in Schenectady, N. Y.

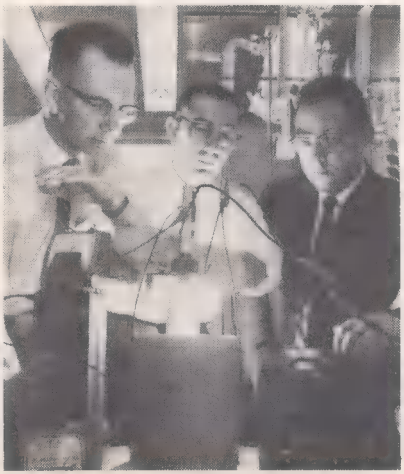
Fuel cells convert chemical energy directly into electrical energy without the use of moving parts. Most fuel cells developed earlier have operated on hydrogen, a fuel substantially higher in cost than the common hydrocarbons

(natural gas, propane, coal, and gasoline). Cost, therefore, is likely to limit the use of hydrogen fuel cells.

However, Dr. Guy Suits, G.E. vice-president and director of research cautioned that "a great deal of research and development remains to be done before fuel cells operating on natural gas become marketable products."

In a fuel cell—as in a conventional battery — electrons move from one electrode to the other, then pass outside through a circuit in which they do useful work as an electric current. Unlike a conventional battery, however, the fuel cell draws its energy from a fuel that is piped in—natural gas, in the case of the new cell—instead of consuming its own electrodes.

Members of the G.E. Research Laboratory fuel cell team grouped around an experimental model of the new high-temperature natural-gas device that they developed.



In the new fuel cell, the natural gas breaks down into carbon and hydrogen. Carbon builds up inside the cell to form one electrode. Oxygen is obtained from air introduced into the other electrode, and oxide ions migrate through the electrolyte, made of zirconia, to the carbon electrode.

The oxygen yields its electrons to the carbon and combines with part of the carbon to form carbon monoxide gas. The electrons are conducted out of the cell as an electric current. To supply heat for the self-sustaining feature of the cell, the leftover carbon monoxide and hydrogen gases are burned within the cell assembly.

for the home

Faceless Ship's Bell Clock

A "ship's clock" has been created for those who would like to have the sound of a true ship's bell in their own home. Called the "Ship's Bell," it is operated by a concealed electric clock mechanism and runs on standard AC household current. The unit may be placed in the den, rumpus room, or any other area of the home. The clock, of course, has no face or dial but it strikes a tone every half hour, in pairs and singly, from one bell to eight bells. These soundings are in four hour cycles, that is, from one to eight bells every four hours. The timing mechanism can be concealed in a closet, under

a counter, or in any other out-of-the-way place. The small ship's gong which sounds the tone is low-voltage wired to the clock. mechanism and may be hung on a wall, counter, or shelf. The clock is available from Tork Time Controls, Inc., Mount Vernon, N. Y.

Nature Flash Cards

A series of nature flash cards called the "Teach-Me about Nature" series is being offered by the Gelles-Widmer Co., 1154 Reco, St. Louis 26, Mo. The written material on the cards is presented in a vocabulary that is designed to be easily understood by children eight years old. The pictures are reproduced in full color in sets on birds, fishes, insects and prehistoric animals. The publishers report that several of the prehistoric animals are pictured for the first time in this set, since recent discoveries have just made the necessary information available. Schools now use "flash cards" as supplementary teaching aids in elementary science courses.

A series of flash cards designed to be understood by children eight years old. They have a picture of the animal on one side and information about it on the other.

Spotlight Screw Driver

A screwdriver that illuminates hard to see places is available from Power Sales Co., Dept. 110, P.O. Box 461, Ardmore, Penna. The unbreakable lens of the light has been built around the chuck that holds the interchangeable driver bits. There are two regular shaped screw drivers, and two sizes of Phillips drivers. With a driver bit in place, the overall length of the unit is 10½ inches; the handle which holds two standard "C" batteries is 7 inches long. The light is controlled by a thumb switch.

Home Steam Bath

A folding steam bath cabinet, designed for home use, is being marketed by Morpul Research Corp., 318 South Driver St., Durham, N. C. The MO-RE-CO cabinet is made of fiberglass and weighs approximately 32 pounds. It does not require plumbing and operates on 110-120 volt household current. The steam chamber size is 31 by 32 by 40 inches. One filling of the compact steam generator is reported to provide up to four hours continuous operation. The unit shuts off automatically when the water level reaches a point ¾-inch from the bottom.

SCIENCE DIGEST QUIZ

1. Most available evidence suggests that there is a layer of dust on the surface of the moon. Although it is doubtful if the dust layer averages more than a few inches, in some parts of the moon it is possible that dust beds of considerable depth could have been formed. (A) What part of the moon is likely to contain the deepest dust beds? (B) How do scientists think these deep dust beds were formed?
2. Scientists assume that erosive action has been forceful on the surface of Mars, but despite this the planet seems to have retained some differences in elevation. What examples can be given of the different elevations on Mars.
3. Sand or bird shot may be capable of disabling or destroying highly sophisticated earth satellites. How can such simple weapons be effective against satellites?
4. The brownish discoloration produced by age on paper is caused by oxidation. A number of substances can give new paper an aged appearance; however, the document investigator has a way of determining if the dissolution is real. What is his method?
5. Handwriting is a conditioned reflex pattern, and each person's handwriting is highly personal. Despite the fact that typewriters are machines, they too show a highly personal pattern. What are some of the ways in which an investigator can determine the differences between samples from various typewriters?
6. Hybrid sterility can occur in degrees. Sometimes one sex is sterile and the other, fertile. In some cases the sterility is incomplete, or may appear in some environments but not in others. The sterility of different hybrids is produced by different causes. At least four types of hybrid sterility have been recorded. What are they?
7. In the Platonic year, the celestial poles describe wide circles finally returning to the point they started at. How long is the Platonic year?
8. Orion was one of the rare constellations in ancient Egypt that modern astronomers have been able to identify with certainty. What relationship may the three brilliant stars of Orion's belt have had with the temple of Abu Simbel?
9. In digging at Troy, Heinrich Schliemann found nine levels of cities built on the site. He thought that the Troy described by Homer was located in the second or third level from the bottom. Today, scholars disagree. Where do they place Homer's Troy?

For answers see the following pages:

1) (A) p. 4, (B) p. 4; 2) p. 10; 3) p. 37; 4) p. 16; 5) p. 21; 6) p. 73; 7) p. 53; 8) p. 57; 9) p. 84.

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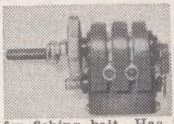

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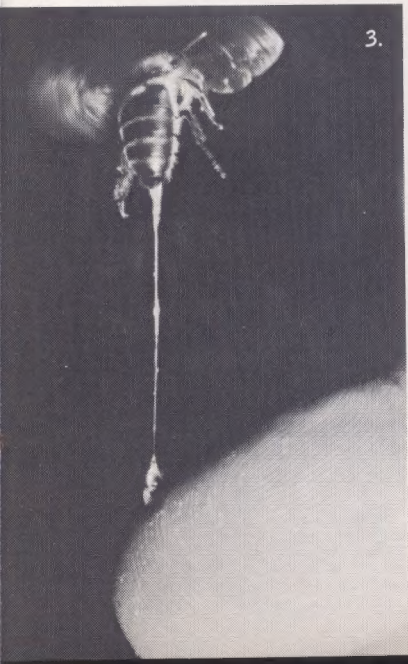
1. A bee guarding the hive sees the photographer and attacks, undaunted by so large a foe.
2. The bee plunges its stinger beneath the skin of the photographer's finger.
3. Flying away, the bee leaves its stinger and poison sac embedded in the finger. Without them the bee cannot survive for long.



ouch!

THIS dramatic series of photographs showing exactly what happens when a bee stings you was taken by Harald Doering. They are part of Doering's book of bee photographs, *A Bee is Born* © 1962 by Sterling Publishing Co. Inc., New York City.

DuPont

SCIENCE DIGEST

A new thermo-plastic polymer is replacing metal in some jobs. One of the uses of the material is for pipe that holds up better than metal pipe under rugged oil field conditions. It is lighter and more easily portable than metal pipe. Sections of pipe can be joined quickly and safely. It is so smooth that it resists clogging, because deposits simply don't have anything to hang on to. One day soon pipe from this material, called Delrin, may be used in water lines in your own home.